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A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

EDITED BY A. S. RUSSELL, M.C., D.Sc.

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No. 7. JULY 1920

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DISCOVERY. A Monthly Popular Journal of knowledge.

Edited by A. S. RUSSELL, M.C., D.Sc., 4 Moreton Road, Oxford, to whom all Editorial Communications should be addressed.

Published by JOHN MURRAY, 50A Albemarle Street, London, W.1, to whom all Business Communications should be addressed.

Advertisement Office: 16 Regent Street, London, S.W.1.

Annual Subscription, post free: Inland 8*s.* 6*d.*; Abroad 7*s.* 6*d.* Single numbers 6*d.* net; postage, Inland 2½*d.*; Abroad 1½*d.*

Editorial Notes

The Oxford University Press General Catalogue for 1920 has been sent me, and the announcement regarding the *Dictionary of National Biography* and the account of the *Oxford Dictionary* will be of interest to readers. The *Dictionary of National Biography* was presented recently to the University by the family of the founder, the late George M. Smith. This, the largest of all national collections of biographies, was designed and the sole responsibility of its production undertaken by the late George M. Smith in 1882. It appeared in sixty-three quarterly volumes from January 1, 1885, to Midsummer 1900: Volumes I–XXI under the editorship of Leslie Stephen, XXII–XXVII under the joint editorship of Mr. Stephen and Mr. Sidney Lee, and XXVII–LXIII (from H to Z) under the sole editorship of Mr. Lee, now Sir Sidney Lee. In order to include notable persons who died during the progress of the work, a Supplement in three volumes (LXIV–LXVI) was published in 1901–2, the date of Queen Victoria's death, January 22, 1901, being taken as its limit. These sixty-six volumes were reprinted, with corrections, on thinner paper in 1908 and 1909 and reissued in twenty-two volumes. The statistical account prefixed to the first volume, and the Memoir of George M. Smith which follows the Preface to Vol. XXII, give particulars of the distribution among the centuries of the lives—more than thirty thousand in number—of the persons commemorated, of the principal contributors to the Dictionary, and of the strenuous life of its Founder, who died on April 6, 1901.

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The Index and Epitome to the Dictionary and First Supplement was designed by Mr. Smith, in consultation with Sir Sidney Lee, as a "summary guide" in the use of the Dictionary and its Supplement, and published in 1903. Containing, as it does, exact names and dates with other details sufficient for identification, it supplies the quickest possible means of finding the article required, whenever the full name or designation of a person is not known beforehand. But as all the articles of the Dictionary without exception appear in it in abridged form, it is in itself within the compass of its two thousand pages a complete biographical dictionary, from which the main facts and dates of a man's life may be ascertained, so that it is an excellent addition to the smaller libraries for which the Dictionary itself is too large. The Index and Epitome to the Second Supplement (1913) is bound in with that of the Dictionary and Supplement.

* * * * *

The "Second Supplement" was undertaken by Mrs. George M. Smith, edited by Sir Sidney Lee, and published in three volumes 1912–13. It contains biographies, 1660 in number, of noteworthy persons who died between January 22, 1901, and December 31, 1911. It has during the war been out of print, but is now being reprinted in one volume, and will be ready shortly.

Preliminary work is now being carried out under the direction of Mr. H. W. Carless Davis, with a view to maintaining and extending the usefulness of the Dictionary.

* * * * *

The following account of the history of the great *Oxford Dictionary* is taken from the Catalogue. The collection of the materials which are used in the preparation of the *Oxford Dictionary* began in 1857

with the appointment, by the Philological Society in London, of a committee for the collection of words unregistered in existing dictionaries. Dr. Trench, then Dean of Westminster, read before the Society two papers in which, "while speaking with much appreciation of the labours of Dr. Johnson and his successors, he declared that these labours yet fell far short of giving us the ideal English Dictionary. Especially, he pointed out that for the *history* of words and families of words, and for the changes of form and sense which words had historically passed through, they gave hardly any help whatever. No one could find out from all the dictionaries extant how long any particular word had been in the language, which of the many senses in which many words were used was the original, or how or when these many senses had been developed; nor, in the case of words described as *obsolete*, were we told *when* they became obsolete or by whom they were last used. He pointed out also that the obsolete and the rarer words of the language had never been completely collected; that thousands of words current in the literature of the past three centuries had escaped the diligence of Johnson and all his supplementers; that, indeed, the collection of the requisite material for a complete dictionary could not be compassed by any one man, however long-lived and however diligent, but must be the work of many collaborators who would undertake systematically to read and to extract English literature. He called upon the Philological Society, therefore, as the only body in England then interesting itself in the language, to undertake the collection of materials to complete the work already done by Bailey, Johnson, Todd, Webster, Richardson, and others, and to prepare a supplement to all the dictionaries, which should register all omitted words and senses, and supply all the historical information in which these works were lacking, and, above all, should give quotations illustrating the first and last appearance, and every notable point in the life-history of every word."

* * * * *

The collection of materials for the supplement was at once begun by the Committee and seventy-six volunteers, but it soon became apparent that the projected supplement would be greater than all the existing dictionaries. Accordingly plans were discussed for a *New English Dictionary*, and Mr. Herbert Coleridge was appointed editor. Under his direction rules were issued for the guidance of volunteer readers, some hundreds of books were read or undertaken to be read, and the editor himself published his Glossarial Index to the printed literature of the thirteenth century. He had prepared lists of words from A to D, and had put into type specimen pages containing articles upon some early words, shortly before his lamented death, in 1861. He had calculated that, when he had one hundred thousand illustrative quotations in his pigeon-holes, it would be time to begin making the Dictionary.

* * * * *

Dr. Furnivall, who was next appointed editor, "realised much more fully the immensity of the work." He pressed on the collection of quotations, divided the letters of the alphabet among volunteer sub-editors, each of whom, it was hoped, would arrange the quotations supplied of words beginning with the letter entrusted to him, classify the different senses of each word, and so leave to the editor only the final redaction of the articles. And, becoming conscious of the great bulk of our early literature which had not been printed, or had been very imperfectly printed, Furnivall founded in 1864 the Early English Text Society, which from that time until now has been engaged in the accurate reproduction of those early writings without which no historical knowledge of English language and literature is possible.

* * * * *

The work thus begun was continued for many years, but could not be brought to completion. The materials accumulated as more books were read, but experience showed that it was impossible for volunteer workers to bring them into a single plan: in the absence of an editor and a staff giving their whole time to the work, gaps in the material could not be discovered or filled, and an attempt made by Furnivall to construct a *Concise Dictionary*, which should show what had been done and what remained to do, broke down after many years of effort. The first enthusiasm of the workers waned when it was found that printing was so far distant; the London and American publishers who were consulted were unable to undertake a work of the magnitude which it was clear would be necessary, and the whole undertaking languished.

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The collections which had been made were too valuable to be abandoned, and in 1878 it was suggested that the Philological Society should invite the co-operation of the Clarendon Press. Negotiations between the Society, the Press, and Dr. Murray, who was by common consent designated as the editor, were entered into, and agreements were drawn up which were finally settled early in 1879. Even at this time the immensity of the work was not fully realised. The Dictionary, it was thought, "would occupy not less than 6,000 and not more than 7,000 pages," and it could be completed, it was assumed, in ten years by a single editor, with a small staff. But when Dr. Murray, in 1879, began his work, "careful examination of the quotations, then for the first time collected in one place and arranged in a continuous alphabetical

series, showed that much work still remained to be done in order to render the material adequate for the purpose. Accordingly a new appeal was made to volunteers to collect additional quotations from specified books, of which lists were from time to time issued. More than eight hundred readers in Great Britain, the United States, and elsewhere, responded to this appeal, and in the course of three years a million additional quotations were furnished, raising the total number to three and a half millions, selected by about thirteen hundred readers, from the works of more than five thousand authors of all periods. About thirty sub-editors (including a few who have never ceased to work for the Dictionary) offered their gratuitous services in arranging quotations, preparing definitions, and otherwise contributing to the progress of the work. Without the aid of these generous contributors and fellow-labourers so great a task could never have been undertaken."

* * * * *

These immense collections, which even before the printing of the work had begun were already thirty-five times larger than had been contemplated in 1860, would have been sufficient in themselves to ensure the supereminence of the Dictionary. No other book has had, and very few ever will have, foundations laid in an inductive investigation of so wide a character. A simple classification of the available material for the various words, an intelligent selection from it, and a careful verification of the references, would have resulted in producing a work of the greatest value and usefulness. The adoption of such a course, however, which in itself would have involved no small amount of labour, was rendered virtually impossible by the very wealth of the material. This continually raised problems and presented difficulties which had not confronted any previous lexicographer, and the solution of these constantly involved prolonged researches in many different fields of study. A single quotation, containing a rare word or some unusual sense of a word, frequently became the starting-point of an investigation, historical or etymological, which might lead to some interesting discovery and explain something previously unknown or misunderstood. At an early stage of the work it became apparent that such researches, if they were to be adequately carried out, would demand ample limits of time and space, and that satisfactory results could only be achieved by the organisation of a large and highly skilled editorial staff, which could have easy access to one or other of the great libraries, and profit by the assistance of many scholars and men of science. To attain this end, Dr. Murray with his staff removed to Oxford in 1885. He was fortunate in the widespread interest which his work excited in this and other countries, and in the many lasting friendships which it made for him. Without the generous help which this interest and these friendships drew from many quarters, it would have been almost impossible to collect adequate materials for the Dictionary. The list of voluntary helpers within the British Islands, many of whom have rendered inestimable service, is so extensive that it must be sought in the prefaces to the various volumes; but something may be said here of the assistance which has come from over the seas. In early stages much help was given by American scholars, whose work was organised and superintended by Professor F. A. March, of Lafayette College, Penn. The preface to Vol. I (p. 15) records large contributions of materials from several Americans, while here, or in other volumes, the names of Fitzedward Hall, W. C. Minor, A. Matthews, C. W. Ernst, etc., are mentioned among those to whom special recognition is due. In another direction, across the North Sea, Mr. Caland, of Wageningen, was for many years a devoted contributor and critical proof-reader.

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Even with all the assistance thus freely given, it became evident, within a few years from the start, that the magnitude of the task undertaken by Sir James Murray had not been fully realised. To hasten the completion of the work, additional editors were appointed.

Dr. Bradley, who had previously worked in London, first giving help with the letter B, undertook the editing of E, and removed to Oxford in 1896. Dr. Craigie, who joined the staff at Oxford in 1897, first assisted in the preparation of G, I, and K, and began independent editing with Q. Mr. Onions, after completing ten years of service with Sir James Murray and Dr. Bradley, was engaged in specially preparing portions of M, N, R, and S, and at the beginning of 1914 undertook the independent editing of Su-Sz.

Thus the editorial list stands at October 1, 1919:

The late Sir James Murray, editor of A B C D, H I J K, O P, T.
Henry Bradley, editor of E F G, L M, S–Sh, and St.
William A. Craigie, editor of N, Q R, Si–Sq, and V.
C. T. Onions, editor of Su-Sz.

* * * * *

Sir James Murray died on July 26, 1915. His great wish that he should live to finish the Dictionary on his eightieth birthday, in 1917, had not been fulfilled; the unceasing labour of three-and-thirty years ended when less than a tenth part of the work remained to be done. Almost within a week of his death he was still spending long hours at his desk. At the beginning he laid the lines and drew the plan; in the prosecution

of the work, when it became clear that it must be shared, his amazing capacity for unremitting labour enabled him to take more than an equal part, and the volumes produced by himself show characteristic excellences which cannot be exactly matched, though they may be rivalled by merits of another kind. "He will not write the last pages, but more than that of any other man his name will be associated with the long and efficient working of the great engine of research by which the Dictionary has been produced."

* * * * *

Including the work of all the editors, the state of the *Oxford Dictionary* in 1919 is as follows. Nine of the ten volumes are complete, and, with the portions of the tenth volume already published, carry the vocabulary without a break from A to THYZLE. V is completed, and only one section of it remains to be published. Most of U is practically ready for the printer and the earlier part is in type. X and the beginning of W and of Y are also in type. On October 1, 1919, the Dictionary extends to 14,080 pages and deals with 376,624 words, illustrated by 1,642,057 quotations.

This completion of the third half-million of quotations contrasts with the original calculations of Mr. Coleridge, that it would be time to begin the making of the Dictionary when one hundred thousand quotations were available.

* * * * *

The seventh volume, containing the words beginning with the letters O and P, contains more words than any of the volumes published so far. The total is 48,870 words—30,300 main words, 6,393 subordinate words, 4,974 special combinations, and 7,203 obvious combinations. Of the main words, 23,120 are described as current, 5,335 as obsolete, and 1,845 as alien. As against the Oxford total of 48,870, no other English dictionary contains more than 27,097. No fewer than 38,365 words in the Oxford volume are illustrated by quotations—no other English dictionary has more than 8,368 words, roughly 30,000 fewer, illustrated by quotations, and the illustrative quotations themselves number 175,130 in the Oxford book, or 154,790 more than in any other comparable volume. Johnson's dictionary contained 4,485 words beginning with O and P, of which 3,661 were illustrated by quotations, the quotations numbering 12,111.

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The number of years which have been required to bring the *Oxford Dictionary* to this point will not seem excessive, when it is compared with three foreign dictionaries which in respect of plan and extent may fairly be said to rival it. These are the *Deutsches Wörterbuch*, begun by the brothers Jacob and Wilhelm Grimm, the *Woordenboek der nederlandsche Taal*, begun by De Vries and Te Winkel, and the *Ordbok öfver svenska språket* of the Swedish Academy. A summary of the past progress and present state of these works affords interesting evidence of the time which is normally spent in the production of dictionaries of this kind.

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The preparatory work for the *Deutsches Wörterbuch* was begun by the brothers Grimm in 1838, but the printing did not commence till the very end of 1851; the first volume, containing A–BIERMOLKE, was completed in 1854. Wilhelm Grimm, who died in 1859, did only the letter D, which forms part of the second volume; Jacob completed the third volume in 1862, and had advanced some way into the fourth at the time of his death, in 1863. Since that date the work has been carried on by various scholars, some twenty in all, eight of whom are specially mentioned in some forms of the general title-page as it appears on the covers of the separate parts. During these fifty-six years the dictionary has progressed from F to an advanced point in S, though part of G still remains to be done. The rest of the alphabet is represented chiefly by continuous portions of T, V, and W, with smaller unconnected sections of S, U, V, W, and Z; most of these minor sections have been produced within recent years, as the result of a special effort to complete the work. With the exception of Vol. IV (which is immensely out of proportion to the others), the first nine volumes and the first part of Vol. X are finished, and carry the work as far as STEIFEN. The second part of Vol. X is also well advanced, and considerable progress has been made with four of the six remaining volumes. The total result of sixty-seven years of printing and publishing amounts to 20,554 pages (equivalent to rather more than 10,000 pages of the *Oxford Dictionary*), and covers about five-sixths of the whole German vocabulary.

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The beginnings of the Dutch dictionary date from 1850–51, and by 1852 the two original editors, De Vries and Te Winkel, had started the systematic collection of materials for the work. It was not, however, till 1864 that the first part made its appearance. After the death of Te Winkel, in 1868, De Vries continued the work with various colleagues until his own death in 1892; since that date the dictionary has been carried on by some of these colleagues and by other editors subsequently appointed. After fifty-five years of publication, the present state of the *Woordenboek* is as follows: Vols. I–VI, containing A to I, are complete with the exception of the latter part of Vol. III, and Vols. IX and X, containing M, N, and part of O, have also been finished. Of the remainder, Vols. VIII and XI have made considerable progress, while Vols. VII, XII, and XIII are less advanced; the latter, ending

at present with RONDVORSCHEN, is the furthest point the dictionary has reached. The portion of the work now published amounts to 14,469 pages (equivalent to less than 6,000 pages of the *Oxford Dictionary*), and contains about three-fifths of the Dutch vocabulary.

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The dictionary of the Swedish Academy is much less advanced than either of the above. The first part appeared in 1893, and up to the present time four complete volumes have been published, with portions of another two. These, however, contain only the letters A, B (incomplete), C, and D (incomplete); five-sixths of the Swedish vocabulary still remain to be dealt with.

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In order to make the *Oxford Dictionary* accessible to scholars and students, it is published at a price which is at least as low as that for any printed matter in book form. The price of a single section of 64 pages is only 2*s.* 6*d.* net, or less than one halfpenny a page. The entire work, so far as it has gone—the first nine volumes bound in half-morocco, and the sections of Vol. X in paper boards—can be purchased for £35 4*s.* 6*d.* net.

Recent Work on Heredity

By J. S. Huxley, M.A.

Fellow of New College, Oxford

(1) THE CHROMOSOMES AS THE PHYSICAL BASIS OF HEREDITY

THE latest advance in general biology has been the discovery that inheritance takes place by means of separable units, generally known as unit-factors or *genes*. It is effecting the same sort of revolution in our biological thinking that Dalton's realisation of atoms as the units composing chemical substances did for chemical thinking a hundred years ago.

But before we can grasp the meaning of this change, we must go over some well-known facts of biology that have been brought to light by microscopical observation. Practically the whole of these facts have been discovered in the last fifty years. Much of the earlier work, especially on the meaning of the observations, was done by Germans, prominent among whom were Flemming, Weismann the great evolutionist, Boveri, and the botanist Strasburger. In later years, England has produced well-known workers in this field in the persons of Doncaster and Farmer, and America in E. B. Wilson. The facts, as we understand them to-day, are briefly as follows:

All higher plants as well as higher animals, when their tissues are examined under the microscope, are seen to be composed of visible units called cells. Each cell consists of a mass of living substance, the cytoplasm, in which is embedded a central denser body, also alive, the nucleus. Although the number of cells in the body of a man is to be reckoned not by millions, but by millions of millions, they are all formed during development from one single original cell, the fertilised ovum. This starts by dividing into two equal halves, then into four, and so on, growth keeping pace with cell-division. When a cell divides, its cytoplasm is simply split into two roughly equal parts. The division of the nucleus is, however, a more elaborate matter. The essential substance condenses to produce a definite number of little threads or rods, which take up many dyes, and are hence called chromosomes, or coloured bodies. Every species of animal and plant has a characteristic number of chromosomes, and in any one species this number is found in every cell. At division, each chromosome is split down the middle, so that each single thread gives rise to two new threads. One of these goes into one of the two new cells formed by the division of the old one, the other into the other. If we were to imagine the chromosomes to consist of a series of small units, of pieces of living substance, strung along them like beads of different colours and shape along a string, each one important in some way for life, and each different from every other, then this peculiar method of nuclear division by longitudinal splitting of chromosomes would be an admirable way of ensuring that all these different units should be divided equally at each cell-division. In other words, each of the two cells produced by division will get half of every unit present in the original cell; and these half-units, being composed of living substance, will grow into wholes, so that all the millions of cells in the body will possess a complete set of these units, and one that is identical with the set which was present in the original fertilised ovum.

This fertilised ovum, however, did not arise out of nothing. It was formed by the union of two cells from the two parents. One, the unfertilised ovum, was detached from the ovary of the mother; the other, the spermatozoon, was detached from the reproductive tissue of the father.

Here comes in a remarkable fact with regard to the chromosomes. In any ordinary cell of the body, the number of chromosomes is, speaking generally, an even one. Sometimes the chromosomes of an animal differ in size or shape, and when this is so they can always be arranged in pairs, so that there are apparently two sets of chromosomes, which may be compared to two packs of cards. The ovum and sperm, however, only contain half the ordinary number, and only one of each pair—in other words, one whole set or pack.

This halving of the chromosome-number before the formation of the reproductive cells is a universal occurrence in animals or plants which possess sexual reproduction, and is known as *reduction*. Thus at fertilisation, one complete set of chromosomes derived from the father is united with a second complete set derived from the mother.

When these facts were first discovered, the theory was promptly advanced that it was by means of the chromosomes that inheritance was to be explained. The ovum and sperm differ from each other in almost every particular of size and shape and constitution. There is only one point in which they agree, and in that they are identical: both possess one complete set of chromosomes. It was therefore natural to suppose that it is by means of these chromosomes that organisms—whether plants, animals, or human beings—inherit characters equally easily, as we know they do, from their mother's or their father's side. We shall see later that this theory has been abundantly justified by the facts that have since been discovered.

Meanwhile, let us not think too much of theories, but merely of the established fact that all higher living things possess in every cell of their body two complete sets of chromosomes, one coming from the father, one from the mother, and that each of these is accurately divided every time that a cell divides.

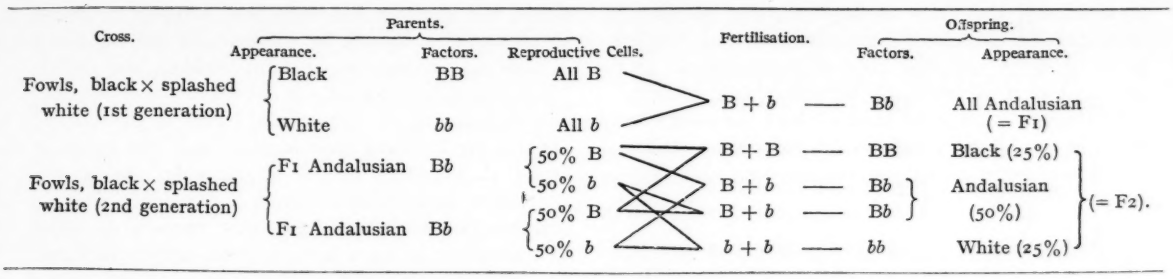
While one set of workers was establishing these facts, others were engaged on extensive plant- and animal-breeding experiments, with results which will be the subject of the next section.

(2) Breeding Experiments and the Idea of Unit-Factors

The other line of attack on the problem of heredity has, of course, been by breeding experiments. Enormous numbers of crosses between different varieties both of animals and plants were carried out during last century, and a number of general conclusions arrived at. But there remained a feeling that we had only scratched the skin of the problem, without any real penetration of its hidden secrets. Then, in 1900, a dramatic event in scientific history took place. Two independent workers, reading through the literature on the subject in the hope of hitting on something to illuminate their results, happened upon an account of some experiments carried out and recorded as far back as 1866 by an Austrian monk, Gregor Mendel, Abbot of Brünn. These had lain unproductive for half a century, like seed in a box. Now at last they were to germinate. Both men realised their importance; they have served as the basis of all the enormous advance that has since been made; and there has sprung into being a new science, of animal- and plant-breeding carried out on the Abbot's principles, and called Mendelism in his honour.

What were the new principles that proved so illuminating? Put as briefly as possible, they are as follows: Wherever one variety of an animal differs from another variety in a constant and well-marked way, these differences can be shown, by cross-breeding experiments, to depend on a definite number of separate characters which can be passed on from parent to offspring—in other words inherited—and each of which can, by proper crosses, be separated from the others. An example will make this clear. There are two races of fowls, the one black, the other white with black splashes. When crossed together, all their offspring in the first, or, as it is often called, the F1 generation, are alike; but they do not resemble either parent. This form of fowl is bluish-black with black lacing, and is called the Blue Andalusian. If these Andalusians are bred together, the next, or F2, generation will consist of three different sorts of fowls—white exactly like their white grandparents, black exactly like their black grandparents, and Andalusian exactly like their parents. These will always appear, if a sufficient number is bred, in the same proportion, the whites averaging 25 per cent., the Andalusians 50 per cent., and the blacks 25 per cent. Mendel, as a matter of fact, worked not with fowls, but with different strains of peas, but got precisely similar results. The explanation he gave was that something which made the black fowls black was present in their reproductive cells, and so handed to their offspring; while in white fowls, a slightly different something was handed on in the same way. These "somethings" may be called *factors*, and the appearances they produce in the adult fowl *characters*. When whites are crossed with blacks, the fertilised egg receives one white-producing and one black-producing factor. The resulting character is neither black nor white, but a compromise, the bluish colour of the Andalusian. When the Andalusian fowls come to reproduce, the Mendelian theory supposes that all the reproductive cells will receive either a black-producing or a white-producing factor, *but not both*.

Let us for convenience call the former B and the latter *b*. There are, then, four possibilities for the next generation. A sperm with B can equally well fertilise an ovum with B or one with *b*; and the same two possibilities are open to sperms containing *b*, and each of these unions is equally likely to occur. Thus on the average, out of every large lot of resulting fowls, one-quarter will contain B + B, one-half B + *b*, and the last quarter *b* + *b*. But B + B will give a black fowl, B + *b* an Andalusian, and *b* + *b* a white. We thus have an explanation both for the sort of fowls produced in the F1 generation, and of the



proportions in which the different sorts occur. In subsequent generations the F2 whites will breed true like the original pure white strain, the blacks breed true like the original black, and the Andalusians will give the same results as their F1 Andalusian parents.

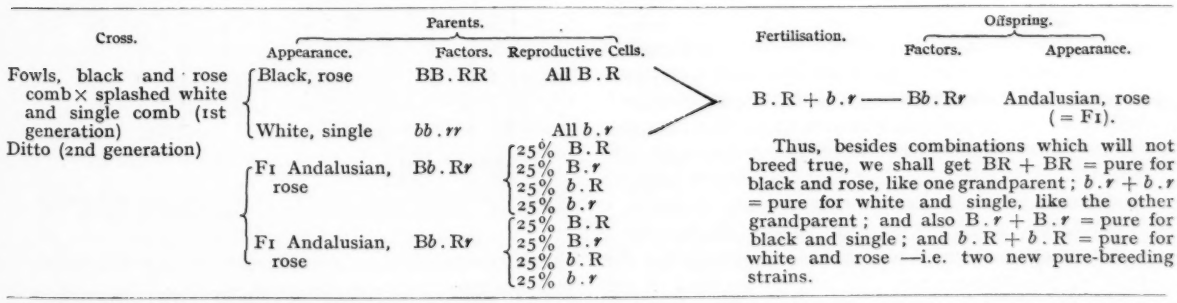
Another character in which breeds of fowls may differ is the shape and size of the comb. If two breeds, one with the ordinary high comb (so-called single comb), the other with a rose comb (a low comb with little warts on it), are crossed, we shall get results precisely similar to those found in the Andalusian fowl. The second, or F2, generation will consist of 25 per cent. of birds which will breed true to single-comb shape, 25 per cent. which will breed true to rose-comb shape, and 50 per cent. which will contain one factor for each of the two comb-shapes, and therefore will not breed true.

The question immediately arises, What will happen if a white bird with a single comb is crossed with a black bird with a rose comb? Will the white colour and single-comb shape stick together, or shall we be able to separate and recombine them? The answer given by experiment is that recombination is possible. In the F2 generation, we shall get two new pure-breeding types—white birds with rose combs, and black birds with single combs—as well as types like the original parents, and types that do not breed true.

Similar results have been obtained by the hundreds of thousands of crosses which have been made during the last twenty years with Mendel's principle in mind, and we can assert, without any fear of contradiction, that for the majority of characters which go to make up any species or race of animal or plant, and to mark it off from other species, the fundamental laws laid down by Mendel hold good.

To be brief, we may say, first, that all the characters of a species are controlled in their development by definite units or factors, which can be handed on from parent to offspring. Secondly, that all such factors are present in pairs, one being derived from the father, the other from the mother. Thirdly, that when the reproductive cells are formed the two members of a pair separate from each other, so that each sperm or each ovum must contain one member of a pair, but cannot contain both; and, finally, that different unit-factors are inherited independently of each other, so that, by making the right series of crosses, we can build up new races or varieties of animals by combining factors for characters of different existing breeds. All kinds of characters have been shown to be inherited by means of unit-factors—colour, shape, size, fertility, vigour, resistance to disease, abnormality, length of life. The external environment may often modify the way in which a character develops; but the basis which can be modified at all, and the limits of the extent to which it can be modified, are provided by the factor and its influence during development.

Through Mendel, the idea of the unit-factor was introduced into the study of inheritance. By the labour of innumerable workers, some of the best-known of whom are Bateson and Punnett in England, Baur



Thus, besides combinations which will not breed true, we shall get BR + BR = pure for black and rose, like one grandparent; b . r + b . r = pure for white and single, like the other grandparent; and also B . r + B . r = pure for black and single; and b . R + b . R = pure for white and rose —i.e. two new pure-breeding strains.

[1] These fowls appear with a rose comb, as rose is what is called *dominant* to single; i.e. rose appears even when only one R is present. Rr birds, therefore, *appear* rose-combed, but do not breed true for comb-shape.

in Germany, De Vries in Holland, and Morgan in America, his principles have been shown to hold good for every sort and kind of characters, in every sort and kind of organism, including man himself.

In the next section we shall see how the most recent work is combining the facts drawn from a study of the chromosomes with those connected with inheritance by unit-factors.

(3) The Chromosomes as the Bearers of the Unit-Factors

In our first two sections we were dealing with facts and principles which, though once the subject of heated dispute, are now accepted as proven by all biologists. In the present one, we are touching on discoveries so recent as to be still in the region of controversy. The principles here set forth, however, though still not accepted by many men of science, are rapidly gaining ground, and are being used as a basis by the majority of research workers in heredity. The writer believes them to be true in all essentials, and certainly to be far better as a working hypothesis to guide our future advance than any others now in the field, and therefore offers no apology for presenting them in a popular article.

In our study of unit-factors, we saw that one of Mendel's laws asserted that unit-factors were inherited independently of each other. This was the original form of the law, and is true for many factors. But as animals were bred on a large scale, and single species were worked on in an intensive way, to study the relation of a great many separate factors to each other, exceptions were found which have made it necessary to restate the law. In its new form, it runs as follows: (1) Unit-factors are inherited in groups. (2) These groups of factors are not inherited entirely *en bloc*, but, though the factors within each group are linked together, the linkage is not absolute. In other words, the factors of one group tend to be linked together in inheritance; but the linkage is not complete, and is of various intensities for different factors. (3) The number of groups is constant for any particular species.

Into the details of the second of the three points we will not now enter. It is the fact that a constant number of independent groups of factors do exist (and this is undoubted) which interests us for the moment.

It will be remembered that observation with the microscope revealed the fact that a constant number of chromosomes was also present in each species. It is, therefore, a natural question to ask whether there is any relation between the number of groups and the number of chromosomes. So far, on account of the enormous amount of time and labour involved in carrying out the requisite number of breeding experiments, the question has only been actually answered for one species, though researches with the same end in view are in progress on many animals and plants. The one form where a definite answer has been obtained is a tiny fly called Drosophila. This is particularly suitable for breeding experiments, as it can be easily kept; it has large broods of offspring, and a new generation appears about once a fortnight. Morgan and his fellow-workers have now records of about half a million of these flies, all with known pedigree. To obtain a record of the same number of generations in man, we should have to go back before the dawn of history. Something like two hundred variations, or *mutations*, have cropped up spontaneously in his stock, and the inheritance of most of these has been worked out. The result has been to show that there are four groups of factors, which is the same number as the number of pairs of chromosomes. Further, the number of factors so far found in each group is roughly proportional to the length of the different chromosomes as seen under the microscope. Morgan and many others, therefore, conclude that the physical basis for the unit-factors is to be found in the chromosomes. If one single factor were to be found not linked to any of the four existing groups, the whole theory would have to be given up, as it would be impossible to reconcile five factor-groups with four pairs of chromosomes.

Other facts (connected with linkage) indicate strongly that the unit-factors are arranged in a row along the

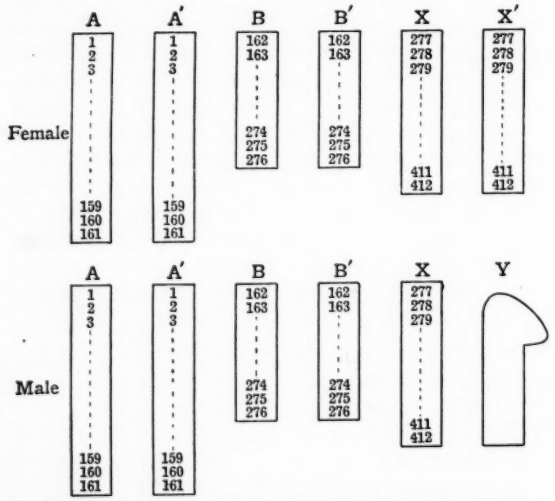


Diagram of the chromosomes in a species with 3 pairs; showing linear arrangement of unit-factors, and difference of chromosomes between the sexes. (See article next month.)

chromosomes, like beads on a necklace. In this, therefore, we have an explanation of the facts observed in the division of chromosomes (see the first section).

It is, therefore, extremely probable that there are

a great number—probably thousands in the higher animals—of unit-factors arranged in two single rows or series inside the nucleus; that this series is cut up into what we see and call the chromosomes, for the sake of convenience of handling at cell-division, etc.; and that the presence of one series—in other words, of one set of unit-factors—is necessary for development to occur and for characters to be handed on from parent to offspring. A glance at the diagram on the previous page will make the general principle clear.

It will be seen that the observed fact of the chromosomes being present in pairs fits with the fact of unit-factors being present in pairs, and that the reduction of the chromosomes explains how only one of each pair of unit-factors is present in any of the reproductive cells.

If the reader has had the patience to follow the discussion till now, he will see that a new way of looking at animals and plants is opened to our intellect. We must think of them, in the first place, as being produced by the interaction of a great number of separate particles of living substance, the factors, each one a separate unit in the original fertilised egg, and each one capable of undergoing lasting alteration (mutating) quite independently of the rest. Secondly, we must think of ourselves and other organisms as being essentially double, with a complete set of these units from father and mother alike. Thirdly, since these units can be inherited more or less independently of each other, sexual reproduction means first a reshuffling of the factors, and then a recombination of them in new arrangements. In other words, if a useful variation in one detail has occurred in one animal, and one in another point has occurred in another, sexual reproduction gives the opportunity for these two separate useful characters to be combined in a single breed. In passing, it may be remarked that this is probably the reason for the almost universal occurrence of sexual reproduction both in animals and plants. Fourthly, we know that these mutations in single factors are constantly happening. At present we do not know how to produce mutations; but the belief that we shall eventually be able to do so underlies our work, and once we have discovered the way, our knowledge of the laws of heredity will enable us to build up improved races of animals and plants as easily as the chemist now builds up every sort and kind of substance in his laboratory. In a word, Mendelism made it possible for us to represent the hereditary composition of an organism by a *formula*. More recent work is making it possible to represent that composition by a *structural formula*.

In the next section, we shall consider the inheritance of sex.

(*For Books of Reference, see p.* 209.)

The Change in the Legal Status of Women

By C. E. A. Bedwell

Hon. Secretary of the Society of Comparative Legislation

ON December 23, 1919, "An Act to amend the Law with respect to disqualifications on account of sex" received the Royal Assent. The operative section enacted that "a person shall not be disqualified by sex or marriage from the exercise of any public function, or from being appointed to or holding any civil or judicial office or post, or from entering or assuming or carrying on any civil profession or vocation, or for admission to any incorporated society (whether incorporated by Royal Charter or otherwise), and a person shall not be exempted by sex or marriage from the liability to serve as a juror."

In order to open all occupations and positions to women the Act (1) reverses what had been regarded as the immemorial tradition embodied in the common law of the country, (2) repeals any statutory enactments which limited specific offices to men, and (3) removes any barriers erected either by tradition or prejudice against the admission of women to certain professions and organisations. The chief exclusion now remaining is a disqualification of peeresses sitting and voting in the House of Lords.

The position given to women by the common law of the country is mainly a matter of history. Although examples may be found here and there of women occupying such positions as Sheriff or Lady of the Manor, the result of historical inquiry is that "in the Middle Ages women had in fact no civic position and did not participate in person in local administration. However, they were not debarred from serving as churchwardens, and in this way other duties devolved upon them. In the sixteenth century, when the State used the officers of the ecclesiastical parish for the discharge of civil functions, the woman churchwarden became bound to act as the coadjutor of the overseer; no legislation was passed to relieve women who were 'substantial householders' from filling the office of overseer, though according to custom they might serve by deputy."[1]

The legal effect of the historical evidence was summed up by Lord Esher in a well-known judgment (*Beresford-Hope* v. *Lady Sandhurst* (1889), 23 Q.B.D. at p. 95) "that by neither the common law nor the constitution of this country from the beginning of the common law until now can a woman be entitled to exercise any public function." Mr. Justice Willes, in an earlier

[1] "The Civic Position of Women at Common Law before 1800," by Miss Rose Graham, F.R.Hist.S., *Journ. Comparative Legislation*, vol xvii., at p. 193.

case dealing with a woman's right to vote, observed " that the absence of such right is referable to the fact that in this country, in modern times, chiefly out of respect to women, and a sense of decorum, and not from their want of intellect, or their being for any other such reason unfit to take part in the government of the country, they have been excused from taking any share in this department of public affairs " (*Chorlton* v. *Lings* (1868), L.R. 4 C.P. at p. 392). In the eyes of the common law a definite distinction was drawn between public activities in any sphere and the domestic avocations of women. Lord Ronan, on the petition of Georgina Frost to be admitted to the office of Clerk to the Petty Sessions, drew a further distinction between (*a*) a judicial and (*b*) a public office ([1919] 1 Ir. R. at p. 100). This has been adopted by a learned American writer, who, after examining the catena of decided cases upon the subject in the United Kingdom and the United States, comes to the conclusion (*Harvard Law Review*, December 1919, p. 297): " Most of the cases concern women's eligibility to administrative offices, and it is generally said, even by courts which hold that there is no ineligibility here, that the eligibility does not extend to judicial and legislative offices. Certainly the capacities required by the three classes of office differ; in each, common law eligibility depends upon custom, and, as there is considerably less evidence of women holding offices of the last two classes, the distinction will probably be maintained. As for administrative offices, the tendency of recent years has been to hold women eligible."

But so far as the United Kingdom is concerned the opening of administrative offices to women had abrogated the common law principle enunciated by Lord Esher. The appointment of Factory Inspector is an example of the manner in which the change has been carried through, although there was no legislative enactment. The Home Secretary being of opinion, according to the Chief Inspector of Factories in his annual report for the year 1893, " that the field for the employment of women, within the limits of their own special capacities and aptitudes, should be as wide and as large as could possibly be made, and that there is no field in which they could be more usefully or fruitfully employed than in looking after the health and the industrial conditions under which their fellow women labour in the factories and workshops," simply appointed two " off his own bat." Another Home Secretary might have adopted the decision in *Beresford-Hope* v. *Lady Sandhurst*, as the Act authorising the appointment of factory inspectors makes no mention of women, just in the same way as the Lord Lieutenant of Ireland refused to confirm Miss Frost's appointment as Clerk of the Petty Sessions (*Georgina Frost* [pauper] v. *The King*, *The Times*, April 28, 1920). Acts of Parliament, judicial decisions, and even the well-established common law of the country give way before common sense supported by public opinion, so that by general consent women have exercised various administrative functions for a number of years. On the other hand, measures like the grant of the suffrage to women can only have effect so far as they are carried into operation by the support of public opinion, expressed by attendance at the polls. Acts passed fifteen years ago by which women were admitted to various public offices still remain almost a dead letter, although women's knowledge and experience are much needed in spheres of local government peculiarly within their province.

There are only ten statutes included in the schedule to the Act of 1919 as being specifically amended by the provision that women will now be eligible for all statutory offices. Four apply only to Ireland and three only to Scotland. The most important of the remainder is the Juries Act, 1870, which embodied the principle of the common law that women were disqualified from serving on juries. Now, however, women possessing the requisite property qualifications must be summoned as jurors. It should be observed that the duty of service to the community in this capacity is obligatory, though a woman may be exempt from service " in respect of any case by reason of the nature of the evidence to be given or of the issues to be tried," or if for medical reasons she is unfit to attend; but having regard to the difficulty in securing jurors she will not readily escape from making her contribution to the administration of justice in the country. These ten statutes, of course, do not exhaust the number which are affected by the new Act, as a large number, like the Irish Act above mentioned relating to Petty Sessions, are not specifically but only constructively limited to men.

The opening of the Civil Service to women is accompanied by the proviso in the Act that " His Majesty may by Order in Council authorise regulations to be made providing for and prescribing the mode of the admission of women to the civil service of His Majesty, and the conditions on which women admitted to that service may be appointed to or continue to hold posts therein, and giving power to reserve to men any branch of or posts in the Civil Service in any of His Majesty's possessions overseas, or in any foreign country."

Although the Civil Service cannot be regarded as one of the close corporations whose doors are opened by the Act, it is probably quite as conservative and bound by prejudice as other bodies who are attacked for possessing those qualities. The provision inserted in the Act without conditions enables the intention to place women on the same footing to be rendered nugatory by administrative action. Before the war the Royal Commission on the Civil Service found that Government Departments had paid little heed to

the principle of " equal pay for equal work." They reported " that highly-qualified women inspectors receive, in many cases, salaries little more than one-half of those paid to men inspectors of similar grade employed in the same department." On the other hand, during the war many women with minor qualifications were paid on a much higher scale than men. It is too soon yet to make regulations which can have any permanency, as there are still a large number of women occupying posts obtained at a time when there was neither time nor opportunity to examine with any exactness as to their qualifications for them. Some years must elapse, therefore, before an estimate can be made of the position of women in the Civil Service and the developments which have resulted from the passing of the Act.

For some reason, which is not quite apparent, the opening of the legal profession to women has attracted special attention. The history of the efforts made to enter under the old regulations is brief. In 1903 the Benchers of Gray's Inn declined to admit Miss Bertha Cave. From the decision of the Benchers of an Inn of Court there is only an appeal to a domestic tribunal of the Judges. Miss Cave's appeal was heard by eight Judges, over whom the Lord Chancellor (Lord Herschell) presided, and among them was the Lord Chief Justice (Lord Coleridge). They took the line that there was no precedent for women being called to the English Bar and the tribunal were unwilling to create such a precedent. It is worth while to recall in this connection that Miss Orme, who was the first woman to take the LL.B. at London University, practised for some years in the chambers of eminent conveyancing counsel, but, in anticipation of a refusal, never applied for a certificate to regularise her position as a practitioner in that branch of legal work. In 1913 Miss Bebb, who has now become a member of Lincoln's Inn, sought a declaration from the Court of Chancery that she was a ' person ' within the meaning of the Solicitors and Attorneys Act, 1843, and the amending Acts, and that she was entitled to be admitted to the preliminary examination held by the Law Society under such Acts. Some authorities were cited of women having acted as attorneys before the year 1322. In order to overcome the necessity to follow the decision in the case of *Beresford-Hope* v. *Lady Sandhurst* it was contended that the office of a solicitor is rather in the nature of a private profession than a public office. In the course of the argument reference was made to the analogous application of Miss Margaret H. S. Hall in 1901 to the Court of Session for admission to the Incorporated Society of Law Agents. The decision was the same in both cases, and Mr. Justice Joyce in the English application considered that only the Legislature could make any alteration.

Similar action has been taken in the Dominions. In Canada the Ontario Legislature passed the necessary enactment within a comparatively short time of the first woman's application. First an Act was passed enabling the Law Society to admit women as solicitors, and then in 1895 an amendment of the previous Act, admitting them to the Bar. A complete list of women admitted in the province was compiled by Mr. Justice Riddell of the Ontario Supreme Court in an article dealing with women as practitioners of law in the *Journal of the Society of Comparative Legislation* (vol. xviii, pp. 200-209). At present Quebec is the principal province which has refused to admit women to the practice of the law, although for some time the legal profession has been open to women in France. The total number in practice throughout the whole of Canada is still very small. The learned Judge sums up his conclusion: " I do not think that the most fervent advocate of women's rights could claim that the admission of women to the practice of law has had any appreciable effect on the Bar, the practice of the law, the Bench, or the people. It is claimed that it was a measure of justice and fair play, that it removed a grievance and has had no countervailing disadvantage. That claim may fairly be allowed ; in other respects, the admission of women is regarded with complete indifference by all but those immediately concerned."

In connection with the admission of women to the legal profession in England it has to be remembered that the Act of last year has only opened the doors. There is no woman yet ' at the Bar,' and there is not likely to be for some time. The Act did not exempt them from any of the qualifying conditions required of men. Some have sought and obtained admission to an Inn of Court, and it is perhaps their entrance to these venerable foundations that has formed the centre of interest. The Inns of Court are popularly regarded as such close preserves that admission to them is placed in almost the same category as the admission of a woman to Masonry. It may be recalled, however, that more than one hundred years ago a woman was for eighteen years organist of the Temple Church. As the organ was then, as it is now, the finest in London, the Masters of the Bench of the two Temples are entitled to claim that they were far in advance of their time in their recognition of a woman's gifts. In the interests of historical accuracy it is necessary to add that she was called upon to resign for neglecting her duty. The Inns of Court are seminaries of learning and education from which, as James I said in his Charter to the two Temples, " many men in our own times, as well as in the times of our progenitors, have by reason of their very great merits been advanced to discharge the public and arduous functions as well of the State as of Justice," and if women are to con-

tribute in public spheres to the government of the commonwealth it would be natural to find their names at least upon the books of the more catholic of the Inns of Court in the same way that royal and noble personages, soldiers, sailors, statesmen, ecclesiastics, dramatists, poets, politicians, novelists and journalists, and many others, are included among the eminent members of the Middle Temple. Whether in due course the women will undertake the practice of the law is quite another matter. In the search for precedents of women occupying themselves in public spheres there appears to be only one of a woman acting as an advocate, when Lady Crawford appeared in 1563 before the Court of Session in Scotland on behalf of a prisoner indicted for manslaughter (*Scots Law Times*, February 9, 1901, p. 126). It is not the present purpose to discuss the auguments for and against that course, but merely to draw the distinction between admission to an Inn of Court and the possession of the necessary qualifications to practise as a barrister, and still more to attain success in that profession.

As the result of the passing of the Act a number of other professions have opened their doors to women. Whether the change in the legal status of women thus effected at the beginning of 1920 will form a landmark in the advancement of the common weal is a matter upon which this generation cannot form a judgment. But at least the Act is the legislative record of a national tribute to the noble work done by women in a great period of stress and strain and a desire not to debar any one of the sex from a sphere in which conceivably she may find some further opportunity for service.

How Wireless Signals are Received

By Lt.-Col. C. G. Crawley, M.I.E.E.

THE ether oscillations which form the waves used in wireless telegraphy are produced by currents of electricity oscillating backwards and forwards at very high speeds, of the order of hundreds of thousands of times a second. These currents, called oscillatory or high-frequency alternating currents, are caused to flow in an elevated wire or system of wires called the aerial, or antenna, from which the wireless waves are radiated into space in all directions. Energy is thus transmitted from the sending station at the same speed as the energy which produces the sensation of light, that is at about 186,000 miles a second, but in this case the ether oscillations are much slower than in the case of light waves.

These wireless waves, which are produced by oscillatory currents, have the property of producing exactly similar currents in any electrical conductor which they meet, and it is this property which is used in the reception of wireless signals.

In wireless telegraphy, by means of a signalling key at the transmitting station, series of ether waves are sent out for shorter or longer periods of time, that is as dots or dashes, and produce oscillatory currents which continue to flow for the same periods in any conductor which they meet. At the receiving station, as at the sending station, the conductor takes the form of a system of aerial wires; and to read signals in the Morse Code, the currents produced in the receiving aerial are made to actuate electrical apparatus in such a way as to produce the dots and dashes as marks on paper, or as sounds in a telephone receiver.

In wireless telephony, the procedure is very much the same, except that the oscillatory currents in the transmitting aerial, and consequently the waves radiated, are modified in strength by the voice in a similar way to that in which the currents are modified in land line telephony. The waves, so modified, produce in the receiving aerial exactly similar currents which actuate apparatus for producing the voice sounds in a telephone receiver.

The strength of the currents in the receiving aerial will, of course, depend on the distance away of the sending station, since the ether oscillations become weaker and weaker as the distance over which the waves travel increases. A powerful sending station is one in which large currents are produced in the aerial, these currents producing strong ether oscillations which allow of the resulting waves being detected by receiving stations at great distances. Signals from the most powerful European stations can sometimes be read even in New Zealand, but efficient communication over these very long distances is not yet a practical proposition.

The Marconi Company's station at Carnarvon is the most powerful one in this country, and communicates as a rule with stations on the other side of the Atlantic, such distances, 2,000 to 3,000 miles, being the greatest over which regular communication is at present conducted. However, a French Government station at Bordeaux, which was designed and partly constructed by the American Army during the war, is very nearly completed, and will have more than twice the available power of any station now in operation.

In these large stations, separate aerials are used for sending and receiving; in fact, the receiving station is usually some miles away from the sending station, so as to allow of arrangements being made for duplex

working—that is, for messages being transmitted to a distant station at the same time as messages are being received from that or another station. In some of the latest designs the most sensitive possible receiving instruments are used, and the receiving aerial is quite a small affair in the form of a loop or frame, as by such arrangements it is easier to eliminate interference from the sending station and facilitate duplex working, at the same time avoiding the great expense of a number of high masts. In the case of Carnarvon, the receiving station is at Towyn, some thirty miles away. The aerial at Carnarvon consists of twenty wires, each

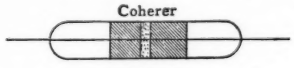


FIG. 1

3,800 feet long, supported by ten masts 400 feet high. The actual operating is carried out at Towyn, the signalling key being connected electrically by wires to the transmitting apparatus at Carvarvon.

In small stations, such as those in ships, the same aerial is used for transmission and reception, being switched over to the sending or receiving apparatus as required.

When signals are received from a distant station, the electric currents produced in a receiving aerial by the waves radiated from the distant station are extremely small, and apparatus must be used to enable these minute currents to release sufficient energy for working some sort of recording arrangement, whether it be one for recording sounds in a telephone receiver, or marks on a paper tape. The apparatus first used was the coherer, which consisted of a sealed glass tube in which were two metal plugs separated by a small space containing metallic filings, as shown in Fig. 1.

Oscillatory currents have the property of very greatly reducing the electrical resistance of the little heap of filings, which are then said to have cohered together, and in this state can allow a current from a cell to flow through them, and work the recording apparatus.

This coherer action was enunciated by Professor Branly in France in 1890, and a coherer itself was first used for laboratory experiments by Sir Oliver Lodge in this country in 1894. In the following year it was used by Professor Popoff in Russia as a detector for aero-electrical discharges, and in 1896 was in use by Signor Marconi as a detector in practical wireless working. This filings-coherer, along with a few other detectors whose working also depended on coherer-action, held the field for some years before being supplanted by more sensitive arrangements.

They were first succeeded by Marconi's magnetic detector, which was introduced in 1901, and quickly followed, though not supplanted, by various electrolytic devices, of which the first practical detector was introduced in 1903, in the United States, by Professor Fessenden.

The magnetic and electrolytic detectors could only be used in conjunction with a telephone receiver—that is, the message was not printed on a tape as dots and dashes, which was the case with coherer devices, but was read by ear as buzzing sounds in a telephone receiver, the duration of the sounds signifying the dots and the dashes of the Morse Code.

At first this fact of not being able to have the message printed on a tape was thought, by those not directly acquainted with practical working, to be a great drawback, as it was said that there could be no certainty that the operator wrote down the message exactly as received; whereas with the dots and dashes printed on a tape there could be no doubt of the matter. The writer well remembers many forcibly expressed opinions from that point of view when it was first suggested in the Navy that aural reception should supplant recorded signals. However, the magnetic and electrolytic receivers were much more sensitive and reliable than the filings-coherer, and it was soon found that this advantage, as well as that of the operator being able to read messages to a certain extent in spite of atmospheric and other interference, far outweighed the disadvantage of not being able to check what was received by reference to a printed tape.

The telephone receiver consists of an electro-magnet fixed close to a circular metal disc supported round the circumference. A comparatively slowly alternating or pulsating current flowing through the coils of the magnet alters the magnetic field in such a way as to vibrate the disc and produce sounds in the ear. The instrument is one of the most sensitive current detectors, but cannot respond to currents which oscillate at such very high speeds as those produced by wireless waves, so that some device must be introduced which will utilise the energy of these currents in such a way as to produce currents suitable for operating the telephone.

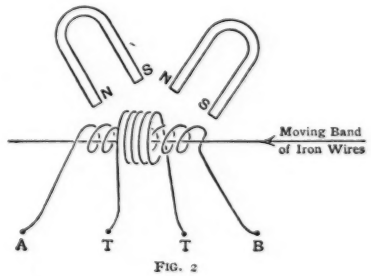


FIG. 2

In the Magnetic Detector (see Fig. 2) the minute oscillatory currents received were passed through the coil AB, and so altered the magnetic field as to produce currents in the coil TT, suitable for working the tele-

phone receiver, which was joined up to the ends of the coil.

In the electrolytic type of detectors, as in coherers, the oscillatory currents reduced the resistance of the circuit in such a way as to allow the passage of a current suitable for working a telephone receiver. The detector consisted of two dissimilar metals, such as platinum and lead, immersed in an acid solution, the platinum having only a small point, the lead a large surface, in contact with the liquid. When at rest, a non-conducting film formed on the point, causing the circuit through the liquid from one metal to the other to have a high resistance. Oscillatory currents disturbed this film, and the resistance decreased so that the current for working the telephone could flow through the circuit.

In 1904 Professor J. A. Fleming in this country invented a detector which he called the Oscillation Valve. This consisted of an incandescent lamp with the addition of a metal plate, or cylinder, inside the bulb, connected to a wire sealed through the glass. When the lamp is glowing, the space between the filament and the plate is electrically conductive, but in one direction only—that is to say, it offers a very great resistance to a current in one direction, but very little resistance to a current in the opposite direction. If, therefore, an oscillatory current is applied, it becomes, for all practical purposes, a unidirectional pulsating current which can be used for working a telephone receiver. The device acts, in fact, as a valve for the oscillations, allowing current to flow in one direction but not in the other, and was therefore called an oscillation-valve, the resulting current being called a rectified current.

Soon after the introduction of the Fleming Valve, another form of receiver, called the Crystal Detector, was introduced. The first practical form was used by General Dunwoody in the United States, and consisted of a crystal of Carborundum in contact with a piece of metal. Various combinations of crystals and metals give a rectifying effect—that is, they convert an oscillatory current, applied across the contact, into a form suitable for operating a telephone receiver.

These Crystal Detectors are still very extensively used in ships and small stations, but the Three Electrode Valve, which was developed during the war, is now used for all long-range work.

This form of oscillation-valve may be used as a generator of electric oscillations as well as a receiver, and is such an excellent receiving and magnifying device that its introduction has undoubtedly opened up new possibilities for wireless communication.

In this valve, as its name implies, there is another electrode in addition to the filament and the plate as shown in Fig. 3. This electrode, called the grid, is usually in the form of a cylinder of metal gauze between the filament and the plate, which may take the form of an outer metal cylinder. If the telephone receiver is connected up in series with a battery across the filament and plate, there will be no sound in the telephone; but if the grid is connected to the receiving circuit so that the oscillations produced in the latter by the incoming signals cause variations of electrical pressure on the grid, then the space between the filament and plate becomes conductive, and currents from the battery flow across this space and produce sound in the telephone.

The valve may thus be looked on as a relay,[1] the minute oscillatory currents received being used to release currents from a battery which can work a

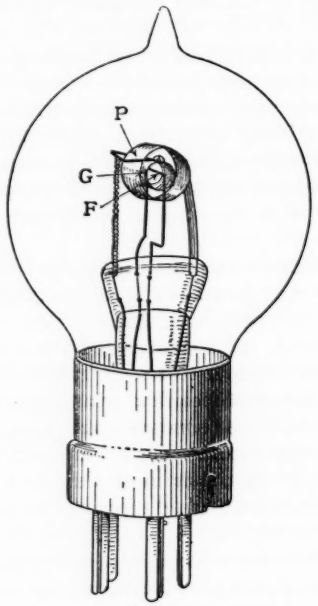


FIG. 3
P=Plate. G=Gried. F=Filament.

telephone or other suitable receiver. This relay action may be further utilised by connecting up a number of valves in such a way that the released battery current from one valve is applied to the grid of the next one so as to release a larger current, and so on.

When used in this manner to increase the effects of the received currents, the valves are said to be used as magnifiers; but there is a practical limit to the amount of magnification that can be produced by increasing the number of valves. It is this magnification effect that makes the Three Electrode Valve such an enormous advance over all other receiving devices, and it is also one of the properties which make it so valuable as a wireless transmitter.

[1] A relay is an instrument which enables a small current to start the operations of a larger one.

It was by means of this apparatus used as a transmitter that wireless telephone messages were sent across the Atlantic for the first time from Arlington, near Washington, to Paris in 1915, and very early in the war it was used as a receiver by the French to intercept, by earth-conduction, messages sent on field telegraph and telephone lines, a practice which both the Germans and ourselves quickly followed. At the time, great surprise was expressed in this country at the intimate knowledge which the enemy had of our intended dispositions in the front line, and a similar surprise at our knowledge was no doubt just as prevalent in Germany. It was not long, however, before both sides had adopted means of sending messages along the wires in such a way as to make interception by the opposing side almost impossible; but there can be no doubt that the first practical use of the Three Electrode Valve, which has so increased the possibilities of communication, involved both the saving and the losing of many gallant lives.

Owing to its magnifying power, the Three Electrode Valve can be used for operating high-speed recording devices; and by using automatic high-speed transmitters, the rate of signalling can be very greatly increased. The greatest speed that can be attained by land transmission and aural reception is about thirty words a minute, and twenty words a minute is considered to be a good working speed. By automatic transmission and reception, using the Three Electrode Valve, a working speed of 100 words a minute is even now quite practicable, and much higher speeds have been experimentally obtained. In fact, it is in this direction that wireless working may show to advantage compared with long-distance submarine cable working in the near future, as such very high speeds are not practicable for the latter. Wireless working, however, whether by telegraph or telephone, is greatly handicapped, as compared with line working, by the fact that it is so liable to be interfered with, or "jammed," by other wireless signalling or by electrical atmospheric disturbances. Recently much has been done to lessen this very serious drawback, but it still remains the great bugbear of wireless communication.

NOTE.—An excellent technical account of this subject is given in *Wireless Telegraphy and Telephony*. By H. M. Dowsett. (Wireless Press, 9*s*.)

BOOKS OF REFERENCE ON HEREDITY

1st Section: L. Doncaster, *Cytology*. (Cambridge University Press, 1920, 21*s*.)

2nd Section: R. C. Punnett, *Mendelism*. (Macmillan, 1919, 7*s*. 6*d*. net.)

3rd Section: T. H. Morgan, *The Physical Basis of Heredity*. (Lippincott, 1919, 10*s*. 6*d*.)

Abraham Lincoln as now Known to Us

By Lord Charnwood

WE must consider first the national struggle in which Lincoln bore the most famous part. Soon after the United States had obtained independence, the slave trade was abolished, and the more northern States abolished slavery within their limits. Farther south the movement in favour of emancipation was checked by economic causes. By the Constitution, slavery was a question for each State to settle for itself. Conflict, however, arose about it in new States and in the territories governed by the United States as a whole. A compromise called the "Missouri Compromise" was effected in 1820 by an Act which made slavery unlawful in existing territories north of a certain line. Economic pressure, however, created in the South a desire to acquire new territory in which cultivation by slave labour could flourish; fanatical belief in the merits of slavery took possession of the South; there was some desire to re-establish the slave trade; Southern traders aspired, encouraged by prevailing lassitude on this question in the North, to get the rightfulness of slavery recognised by the law and tradition of the whole Union. In 1854 the "Missouri Compromise" was repealed. The Republican Party then arose in the North, pledged on the one hand to leave slavery unmolested where it was already lawful, and on the other to prevent its extension over any present or future territory of the United States where it had not been legalised already. In the State of Illinois great service was done to the new party by Abraham Lincoln, a lawyer in fair practice, who had been born in 1809, on the then frontier, in poor and rough surroundings. He was distinguished as a youth equally by his physical prowess and by his determined self-education, and had entered early upon a political career which for a while prospered, but had latterly lost interest in politics. Lincoln's action henceforward was marked by his reasoned and inflexible tenacity of both parts of the Republican position. In 1860 he proved to be the most available candidate of his party for the Presidency, and in November of that year was elected President, owing to a split between the Southern politicians and the party in the North which was most favourable to them. Upon his election, seven Southern "slave States" successively seceded from the Union and formed a new Confederacy; four more slave States on the border joined them when hostilities broke out; while more adhered, as did all the "Free States," to the Union. Lincoln entered office in March

1861, and within a few weeks the forces of the new Confederacy bombarded a fort at a Southern harbour which was held by the Union troops. The war which followed was just being brought to an end when Lincoln, after being again elected, was assassinated, in April 1865. It must be noted: first, that, while the whole South was devoted in maintaining its right to independence, slavery was avowedly the only cause for which the majority had chosen to exercise that right; secondly, that, while every shade of opinion as to slavery existed in the North, there was unanimity at first in declaring that the South had no right and ought not to be allowed to secede.

The reputation of Abraham Lincoln has grown in the fifty-five years since his death in a remarkable degree. This is partly the result of the disclosure from time to time of facts showing the inner history of his administration, and partly because the main features of his statesmanship can now be seen in truer perspective. When his party chose him as their candidate for the Presidency of the United States, it was less from any general recognition of his merits than from the antagonisms which had arisen to other men better known and apparently better qualified than he. One or two men of remarkable sympathy and discernment, such as Motley and Lowell, saw before long some great quality in him, but to most people in the eastern States he continued for long to seem a coarse frontiersman, while men of his own State thought of him as just one of themselves. His honesty of purpose and sincerity of utterance were very soon recognised, but people associated them with an artless simplicity, which was indeed the very opposite of his subtle, far-seeing, and reticent character.

The North sustained defeats in the war which were the more humiliating because it was far the superior in resources. It was natural to attribute this to feebleness in the administration. Moreover, the Northern people (not to speak of that minority among them in whom any defect sufficed to bring out pacifist inclinations) were deeply divided. There were those whose support of the war was confined to a determination that the Southern States should not break away from the Union, especially in certain border States whose adherence was essential to the North. There were those to whom, civil strife having once arisen, it seemed obvious that the war must be converted into a crusade against slavery, since slavery was in itself detestable, and was the whole cause of the war. Clearly understanding the point of view of both these sections, Lincoln was bound by conviction and the necessities of his position to hold aloof from both, take his own course, and keep his own counsel. Therefore both regarded him as a weak President.

Then came his assassination in the hour of victory. The pathos of this blended with the recollection of his early hardships and struggles. Besides, the man's own character had been surely gaining him sympathy. After all, he had stood the racket of the war and won through. He might have been weak, but he had been brave and patient and self-effacing. Several of his speeches were of the sort which might pass unnoticed at the moment, but would recur and recur to the mind as among the best-loved classics. And he had a certain mystery and charm, a combination of overflowing humour in his ordinary intercourse with a deep and dignified melancholy detected even by passers-by, such as grows and becomes haunting. Above all, he had been infinitely merciful and kind. So the memory of the tender-hearted conqueror became dear to Americans, as typical of the best element in their own nation, and as the memory of a very great man, about whom it was a secondary question whether he was really a great President.

But he was a very great President, whose conduct American statesmen long after, such as Colonel Roosevelt and Mr. Taft, have studied closely and treated as the supreme example of statecraft. And his statesmanship lay so much in applying to great affairs the wisdom and goodness of common life, and his skill in office was so much of a piece with the blended traits which make his strange personality fascinating, that his character has an importance to the world at large. It enhances his merits to remember that he had all the temptations which arise from an ambitious temperament, from a certain lax good-nature, and from education in the petty ways of a politician of the old school.

We may first consider his conduct of the war. The North had a terrible task before it in the conquest of the vast and difficult country of the South. There was no general staff to advise Lincoln; the North had but few trained commanders, and at first none capable of large operations; untrained, unproved men had to be encouraged and tried; local influences and popular pressure could not be ignored without disaster. The South had at first a relatively simple problem in defending itself, and was singularly favoured with military leaders. It is also plain now that Lincoln wrestled with these difficulties with wonderful patience, but the complaints of particular officers against him, and the legend of his unwise interference in military matters, still colour the views of historians. The whole question can be adequately tested by Lincoln's controversy with General McLellan, who in 1861–2 commanded the great army operating against the Confederate capital Richmond, one hundred miles south of Washington. Half the North rated Lincoln for supporting this timid general so long as he did, but

the failure of his successors, and the praise of him by the great Southern antagonist, Lee, settle the point. Soldiers, naturally sympathising with an unfortunate commander, complain, on the other hand, that Lincoln did not give McLellan a fair chance. Three points in the controversy may suffice. First, Lincoln, though rightly yielding his judgment to McLellan's, long pressed him to advance due south against Johnston's forces near Washington. We now have Johnston's own account of his position, and it is decisive for Lincoln. Secondly, when McLellan was carrying out his own plan of attacking Richmond from a sea base lying south-west of it, Lincoln withheld certain forces from him. Now, it is incontestable that McLellan's demands would not, on his own showing, have left Washington sufficiently protected, that the loss of Washington would have been a deadly blow to the North at that time, and the loss of Richmond would have been but a slight blow to the South. Thirdly, when McLellan had been superseded, but reinstated in command after the disastrous failure of his successor had resulted in an invasion of the North, and when he had warded off that blow but failed to follow up his success, Lincoln abruptly and finally removed him. It is now at last known that, when Lincoln did this, he had received trustworthy information that McLellan was in treaty with pacifists in the North to let the South down easily, in consideration of their support for the Presidency. These are tiresome matters, but they show that at point after point Lincoln acted rightly where he had been obviously wrong, and we may accept it that this inexperienced man proved a strong administrator before we proceed to consider whether he was an enlightened statesman.

(To be concluded next month.)

Some Aspects of Carbide in the Light of Recent Discoveries

By Edward Cahen, A.R.C.Sc., F.I.C.

THE average cyclist or motorist who buys a tin of carbide never gives it a further thought. He just fills up his lamps, and there the matter rests. He does not ask what the stuff is, how it is made, or of what materials it is composed. And yet, if he only knew, the whole life-history of carbide is one of absorbing interest. Everybody to-day knows all about coal-tar and the marvels the chemist has effected with this apparently valueless and messy material: coal-tar colours are the commonplace of every exhibition; but one never hears anything about another waste-product of the gas-works, the coke that is left behind in the retorts after the gas has been distilled off with the tar and the ammonia. Now, it is from this coke, together with another very common substance, ordinary quicklime, that the carbide is made. To-day, for one nation to wage war on another with any chance of success, that nation must be possessed of sufficient supplies of at least three absolutely essential materials—nitrates, acetone, and tungsten—to say nothing of armies of men to make use of the products provided by the ingenuity of the chemists and metallurgists. Under the circumstances, it seems almost incredible that Great Britain went to war in the cause of right without assured supplies of any one of them, though it must be admitted that our Navy made it tolerably certain that we should be able to get nitrates across from Chile in quantities large enough to meet our every demand. Now, of the three substances of such paramount importance, two are directly capable of being obtained from carbide. It is for this reason that this material has assumed an importance which it has never held before.

The credit of first preparing carbide must be accorded to Woehler, a German chemist of renown, who in 1862 succeeded in making very small quantities of this material by a very lengthy and somewhat costly process, and at the same time he showed that it gave rise to a gas when it was moistened with water. Calcium carbide and the resultant gas, acetylene, however, remained mere chemical curiosities for another thirty years; and it was not till after the discovery and development of the electric furnace that carbide was manufactured on a commercial scale, and even then more or less as the result of an accident, Thomas L. Wilson was experimenting with the electric furnace, trying to get metallic calcium by heating carbon and lime together. On tapping the furnace, he found that he had a dark-coloured liquid mass, which on cooling solidified to a brittle crystalline solid. Now, if calcium had been formed on dropping this solid into water, hydrogen gas should have been given off; when this was tried, however, a gas came off which certainly was not hydrogen, for it burnt with a bright, smoky flame very unlike the flame of hydrogen, which is very nearly colourless. This new substance was calcium carbide, the same as Woehler had prepared so many years before. From such small beginnings, one discovery leading to another, this experiment led to unexpected developments.

When lime is heated with coke to the great temperatures now so easily attained with the modern electric furnace, combination takes place, with the

evolution of a very poisonous gas, carbon monoxide, which fortunately soon finds some more oxygen in the air with which to combine to form the harmless gas, carbon dioxide, that we exhale. The chemist expresses these changes very simply by the two equations:

CaO	$+$	$3C$	$=$	CaC_2	$+$	CO
(Calcium Oxide, or Lime)		(Carbon, or Coke)		(Calcium Carbide)		(Carbon Monoxide)

CO	$+$	O	$=$	CO_2
(Carbon Monoxide)		(Oxygen)		(Carbon Dioxide)

At first the newly discovered carbide was merely used for generating acetylene for lighting purposes; and even for this many brains had to be racked and many inventions made to find out how to burn the gas without the smokiness of the flame, and how to generate it to get a constant supply without fear of explosion. The advantages of the gas for lighting railway trains, vehicles, etc., soon became apparent, and it was not long before its use was adapted for lighting isolated houses in the country. In England it has not gone much further than this stage, but in the United States and Canada it is not at all uncommon to find small townships supplied with the gas as a municipal enterprise.

The next step in the history of carbide was the discovery that acetone would dissolve about twenty-four times its own volume of acetylene at ordinary temperature and pressure, and very much more when compressed, thus affording a ready and safe means of transporting the gas in a handy manner. Iron cylinders packed with asbestos rings soaked in acetone were constructed, and the gas pumped in under pressure. With what to all intents and purposes was solid acetylene, it was not long before an entirely new use was found for the gas—namely, as a substitute for the hydrogen in the oxy-hydrogen blowpipe or torch, as it is sometimes called. Acetylene, even when it burns in the air, gives a very hot flame, but when oxygen is substituted for the air, the heat of the flame is greatly intensified. The temperature of the oxy-acetylene flame is estimated at anything between 6,000° and 7,000° Fahrenheit. The process of oxy-acetylene welding, in which these torches are used, dates from 1903, and has found a hundred different uses since then; and as a direct outcome of it, a still newer process, that of the "cutting blowpipe," may be mentioned in passing. By means of the latter, all forms of steel may be cut much in the same way as the grocer cuts through a piece of cheese with a steel wire, and with as little effort. The heat is so intense that the cut is clean, there being no time for the metal to melt before the flame passes on. To-day, only seventeen years after its invention, acetylene welding and cutting has become a common feature of every engineering shop and shipyard.

In the March issue of this magazine, in an article on the Source of Nitrogen, I told the story of how carbide had come to our aid for this all-important purpose; how, when it was heated with nitrogen, cyanamide was formed, from which all sorts of nitrogenous products could easily be obtained. Great as this discovery is, it seems but a little thing in comparison with the achievements of the chemists at Shawinigan, in Canada, during the war. The cheap electric power derived from the Falls of Shawinigan had already made this spot the centre of the Canadian chemical industry; carbide was already being made there on a large scale and of excellent quality, and many other allied industries had sprung up in the same district.

As has already been indicated, acetone is one of the essentials in warfare, for it is used in the manufacture of cordite, the standard British explosive. Cordite is not what is known as a high explosive, but is used in enormous quantities for propelling the shells, carrying the latter through the air. When one realises that it is cordite which fills the body of the huge shells used on our ships, one gets a faint idea of the demand there must have been for this material, and consequently for the acetone used in its manufacture. Although acetone does not really enter into the constitution of the finished cordite, but, like the water used in bread-making, really only assists in the mixing process, it is found in practice that little more than half can be recovered to be used again. There is little wonder, under the circumstances, that the Government soon found themselves at a loss for further supplies. Acetone is normally obtained from the distillation of calcium acetate, itself obtained from the destructive distillation of wood. This source of supply was soon found to be entirely unable to cope with the demands put upon it. Desperate efforts were made to obtain the precious liquid from any source whatever; fermentation processes were resorted to, and any starch products which could not be used for food, such as spoilt rice, for instance, were turned to account. Even village children were called in to assist, by collecting horse chestnuts, throughout the length and breadth of the country, and these were sent to the Government cordite factory at Holton Heath, near Bournemouth, in the hope that they would furnish a cheap and otherwise useless source of starch; the difficulty of getting at the starch through the various integuments of the nuts, however, proved insuperable. Late in

1915 the British Government, in their difficulty, turned to the Shawinigan Water and Power Company, to see whether calcium carbide could not again be called in to help in an emergency, as it had already done in the case of nitrogen from the air. At the time a good deal of literature existed dealing with synthetic methods of preparing acetone and similar products from acetylene, but hitherto no attempt had been made to produce the former on a commercial scale. Experimental work was started in December of that year, and after six months the construction of the plant was begun. In January 1917 acetone was being shipped to Europe. What a marvellous achievement when one thinks of it: acetone from coke and lime!—it reads like some tale from the *Arabian Nights*. The process, the main outlines only of which can be given here, falls naturally under five heads.

In the first place, acetylene had to be produced from the carbide in very much larger quantities than had ever been done before—some five or six hundred thousand cubic feet per day, in itself no mean achievement. Secondly, large quantities of mercuric oxide were required as a catalyst,[1] and this had to be made by the cheapest method possible. An entirely new electrolytic process was devised. The oxide of mercury was removed, as it was formed, in suspension in caustic soda, which was used as the electrolyte. The oxide was then allowed to settle out, which did not take long, as it is very heavy, the caustic soda being used again.

The third operation was the most difficult of all: the acetylene was passed into sulphuric acid in which the catalyst, the mercuric oxide, was suspended. Under these circumstances another gas, acetaldehyde, was formed, and this was drawn off with the unused acetylene, and separated from the latter by condensation by cooling to a low temperature.

The next step was a comparatively simple one: it consisted of oxidising the aldehyde to acetic acid. For this purpose oxygen is required, and as it was found impossible to get Linde-compressors for this purpose, air had to be utilised and a means devised whereby the oxygen could be extracted. Here again a catalyst had to be discovered. Large quantities of nitrogen were liberated as a result of this operation, which no doubt will be made use of one day to make cyanamide. The matter, however, was not of sufficient importance during the war to make it worth while recovering this waste product; all energies had to be devoted to the production of the acetone.

Having arrived at the acetic acid stage, it only remained, in the fifth and last step, to obtain acetone from this material; and here, again, this involved the discovery of a suitable catalyst, that would bring about the change. After a number of experiments, hydrated lime, with a little magnesia, was found to give the best results.

Cast-iron balls were coated with a wet paste made of these materials, and they were then placed in a long tube which could be electrically heated. After drying the catalyst on the balls, the vaporised acetic acid was passed through the heated tubes at 485° C., and it was found that the conversion into acetone was well-nigh complete. Some seventy-two of these tubes were installed, capable of producing some ten tons of acetone a day. The products from the tubes were then passed through a soda-ash scrubber, to remove the small quantity of unchanged acetic acid, which amounted to some 5 per cent. The acetone, after washing, was finally rectified in the usual way.

The cost of production of acetone from carbide was found to be much greater than ordinary commercial conditions would permit; and had it not been for the urgent need of this spirit by the British Government, the process might never have been carried through to its ultimate conclusion. It was not, therefore, a matter for deep regret when it was learnt that the need for acetic acid was greater than the need for acetone, and a request was received that they would export the former in place of the acetone, which was at first required. The need for acetic acid arose from the enormous demands made on this material for making cellulose acetate, which is used in dope for aeroplane wings.

From November 1917 onwards to the present time, the plant has accordingly been used entirely for the production of acetic acid, and, when America came in, a second plant was erected for the United States Government for the same purpose. At the signing of the Armistice this plant was just complete, and the two together would have been capable of producing some 1,600 tons of acetic acid per month. To-day the company is manufacturing synthetic acid on a commercial scale, and are able to compete very favourably on the open market. The purity of the acid, which is well over 99 per cent., is a point greatly in its favour. As to the future of other synthetic products which could conceivably be made from acetic acid, time alone will show whether they could be made a commercial success. There is no doubt but that developments could be made along the same lines as those for the production of acetone,

[1] As the whole process depends, like so many other synthetic methods, on the proper use of catalysts, it may be as well to explain exactly what is meant by this term.

By a "catalyst" the chemist means a chemical or some similar substance which helps on the reaction, but is itself left practically in the same condition at the end as at the start of the proceedings. Nearly all industrial processes depend in some way or other on the careful choice of a catalyst; the whole subject has been very carefully studied of late years.

and M. J. Marshall, of the Shawinigan Laboratories, in a paper in the special Shawinigan number of the *Canadian Chemical Journal*, gives a very good summary and review of the possibilities of the future, with a table, arranged like a genealogical tree, showing the relationship of the various products and how they can all be derived from acetylene, itself the product of coke and lime. In this table it is, to say the least, striking to find such important substances as rubber and alcohol, thus showing how far a war-time necessity may lead should the occasion arise and the pinch of necessity make itself felt.

NOTE.—The reader will find a very much fuller account of this subject in the *Canadian Chemical Journal* for August 1919. This contains many illustrations and diagrams. The articles are by many hands, and the whole subject is treated very fully.

Notes on the New German Constitution

By G. F. Bridge

A TRANSLATION of the new German Constitution has appeared in Mr. Charles Young's book *The New Germany*, and an examination of it may not be without interest. It is a remarkable combination of old German political ideas with advanced contemporary conceptions of the functions of the State. It embraces not merely government and administration—what we are accustomed to call politics—but it includes in its purview education, religion, the welfare of the child, the mother, and the labourer, and social and industrial organisation. The result of a struggle between political parties, it bears throughout the marks of compromise, and in some cases adjacent clauses appear to be, if not contradictory in a legal sense, at least inspired by a contrary spirit. But the new Constitution is not, like Bismarck's schemes, a compromise between centripetal and centrifugal forces, but the result rather of the clash of socialism and individualism. The old "States," one gathers, did not show much fight. They are reduced to ghosts and shadows. Their very name has disappeared, *Land* having been substituted for *Staat*—an expressive change, for *Staat* implies a self-governing unit, *Land* as here used merely a division of the country. The Constitution of *das deutsche Reich* is practically a unitary Constitution. In every matter on which a Government can legislate the *Reich* "has exclusive authority," or "has legislative authority" or "the right to legislate," or it "can frame general principles." The exact shade of difference which exists between some of these "authorities" and "rights" may be left for constitutional lawyers to discuss: the general outcome is that the Central Legislature is all-powerful, and may give to the Local Legislatures or withhold from them what powers and functions it thinks fit. For Local Legislatures will still exist. "Every *Land*," says Art. 17, "must have a liberal Constitution." Nay, more, there are provisions for the creation of new *Länder*, just as there are for the recognition of new States of the American Union; the consent of the inhabitants, signified by votes, being an essential condition for any such creation or for any change of frontier between *Länder*. But it seems likely that practically little power will be left to the subordinate Governments, except some measure of control in religious matters and education, some right to own commercial undertakings, and the right to "make treaties with foreign States on matters which fall within their own legislative competence" (Art. 78). The ancient glories will depart. Bavaria and Würtemberg will give up their postal departments and their stamps; all railways, waterways, and marine lights are transferred to the *Reich*, and there will be only one army for the whole country.

The most substantial remnant of the old German federative system to be found in the Constitution is the *Reichsrat*, the Second Chamber of the Legislature, which takes the place of the old *Bundesrat*. This is formed of representatives of the *Länder*, on the basis of one member for every million inhabitants, with the proviso that no *Land* shall have more than two-fifths of the total number of votes, an echo of Bismarck's politic provision for preventing a Prussian majority in the *Bundesrat*. The *Reichsrat* has apparently equal powers with the *Reichstag* in legislation, though the second sentence of the section on Legislation, "Acts of the Realm shall be passed by the *Reichstag*," seems to suggest that the latter body is to be regarded as the principal law-making authority. But, however that may be, the rights of veto and initiation are secured to the other Chamber. The solution for cases of disagreement is to be the Referendum. The President of the Realm can refer the issue to the people, and if two-thirds of the *Reichstag* are against the *Reichsrat*, he must so refer it, or else proclaim the Bill to be law, over the heads of the latter body. If the *Reichstag* insist on their position by a mere majority, apparently it rests with the President either to drop the Bill or to take a plebiscite.

The Referendum plays a considerable part in the Constitution. The President can refer any act of the *Reichstag* to a popular vote. One-third of the members of the *Reichstag*, supported by one-twentieth of the voters, can demand such a reference. One-tenth of the voters can demand the introduction of a Bill. On

the other hand, there is no special stipulation for a plebiscite in the case of a proposed amendment of the Constitution; the only peculiar provision being that, if a plebiscite be held by popular initiation on a constitutional amendment, a majority of the Electorate must be in its favour (Art. 76). The ordinary procedure for effecting a change in the Constitution will be by legislation in Parliament, a two-thirds majority in a House where two-thirds are present being required in the *Reichstag*, and two-thirds of the recorded votes *in the other House*. The amendment of the Constitution will not be hampered by so many difficulties in Germany as in the United States.

In the Constitution of the Central Government there are some interesting reminiscences of the old imperial system. The President, who, by the way, will be "elected by the whole German people" (Art. 41), will appoint the Chancellor, and the Chancellor will recommend the other Ministers to him for appointment. "The Chancellor lays down general policy and is responsible therefore to the *Reichstag*" (Art. 56). Nevertheless, in Art. 57, though here only, a "Cabinet" is recognised. But Art. 54 reveals the fundamental change beneath the superficial resemblance: "Chancellor and Ministers of the Realm require the confidence of the *Reichstag* for the exercise of office. Any one of them must resign should the *Reichstag* withdraw its confidence by express resolution." It is noticeable that in this connection no function is assigned to the *Reichsrat*.

A section consisting of twenty articles is devoted to "The Individual," but here we need notice only the remarkable Article 113: "The foreign-speaking parts of the Realm shall not be obstructed, either legislatively or administratively, in the free development of their ethnological characteristics, especially in the use of their mother tongue, in educational establishments, in internal administration, and in the administration of Justice." In the next section headed "The Community," a remarkable point is the guarantee of complete freedom, for the formation of associations and unions, including those of a religious nature. All such associations can acquire corporate rights, a provision which, as Mr. Young notes, repeals the Prussian law which required special legislation for the incorporation of a religious association. This principle is further laid down in Art. 137, which contains also a remarkable clause, empowering "religious associations which are public corporate bodies to tax their members on the basis of the rate assessments and subject to *Länder* legislation." A religious denomination will apparently be able to collect revenue forcibly from its adherents; the individual will be able to avoid the assessed tax only by leaving the religious body. Such a clause reveals the influence of the Roman Catholic and Evangelical Churches; cheek by jowl with it is another which shows the strength of the Socialists: "Associations whose aim is to promote the cult of a common view of life shall be on a par with religious associations." Thus are Secularism and Religion placed on a level in the eyes of the law, and a Bolshevist or Agnostic Brotherhood will have the same rights as an ancient Church. The property of all religious bodies is guaranteed to them, though, of course, all State Churches are abolished. Endowments will therefore remain, at least for the present. The anti-religious element in Germany is evidently much less strong than it was in France in 1790, or than it is in Russia. The educational system adumbrated by the Constitution is based on the foundation-stones of democratic unity and secularism. Art. 142 declares that "art, knowledge, and their instruction are free." The next article provides that "the training of teachers shall be uniformly regulated for the whole Realm on the general lines laid down for higher education": apparently in this all-important matter neither *Länder* nor Local Authorities will have any voice. The *Einheitschule* is established by Art. 146: "The foundation school, which shall be common to all, shall lead on to the secondary and higher school system." Private preparatory schools are abolished, no doubt as being inconsistent with the principle of the *Einheitschule*; but, on the other hand, private elementary schools may be established if "a minority of parents and guardians have no public elementary school for their faith or views, or if the educational administrative authorities recognise that special educational interests are involved" (Art. 147). Nothing is said about the possibility of such schools receiving grants or accepting pupils with public scholarships. Express provision for such scholarships, including maintenance grants, is made, probably for the first time in the fundamental law of any people.

Apparently schools will be in general secular, though it is nowhere so expressly stated. But there is an important provision by which, on the demand of parents or guardians (the number or proportion is not specified), "Elementary schools for their particular religious faith or their particular views shall be set up within a municipality" (Art. 146). Here again we note that the Secularist and the Christian are treated alike; the Communists in a predominantly Catholic town have the same right to demand a school of their own as the Catholics in a predominantly Socialistic town. About country schools nothing is said. All schools are to "aim at inculcating moral character, a civic conscience, personal and professional efficiency in the spirit of the German national character and of

international conciliation" (Art. 148). Except in non-religious (secular) schools—it is curious that in this Article 149 these are spoken of as if they were the exception—religious instruction in accordance with the views of the denomination or body concerned will be given. The question by whom the teachers of these schools are to be appointed is nowhere touched, and as the next clause states that "the giving of religious instruction and the instituting of Church ceremonies shall be dependent on the consent of the teacher," the denominational bodies have obviously a serious problem before them.

Lastly, it may be noted that the theological faculties in the Universities are to be maintained.

That part of the constitutional document which bears the title "The Economic System" breaks, as Mr. Young says, new ground. For its provisions there is no precedent in any former Constitution: it is a wholly German contribution to the art of organising social industry; and as it is the most original branch of the fundamental law, so it may well prove to be the most fruitful and far-reaching in its results. It sets out with the principle that "the social economic system must conform to the principles of equity, with the special object of guaranteeing an honourable livelihood to all." It guarantees freedom—freedom of trade and manufacture, freedom of contract, freedom of association—and it guarantees property, at the same time as it lays down the principle that "its use by the owner must serve the common good" (Art. 153). Private ownership in land is recognised, but "distribution and cultivation of the soil shall be supervised by the State," and "all riches of the soil and all natural resources of economic use shall be under the supervision of the State," and "increment value shall be utilised for the common good" (Art. 155). As for the public good the State will supervise agriculture, so also for the public good it may organise industry. It may "transfer to public ownership private business suitable for socialisation" (Art. 156). Is "socialisation" here equivalent to "nationalisation"? Apparently not, for the next clause gives the State power "to name itself, the *Lands*, or Local Authority, as partners in the administration of such business undertakings." Further, the *Reich* may, by legislation, compel business undertakings or associations to combine, "with a view to securing the co-operation of all the productive forces of the nation, to associating employers and employed in the administration, and to regulating production, manufacture, distribution, employment, prices, as also import and export of goods, on principles of public economy." Here we have the German proposing to do, by the conscious and deliberate action of the State, what in other countries is being done by the action of individuals and self-organised bodies. Finally, the State is to throw its protecting mantle over Labour: "the labour forces of the nation are under the special protection of the Realm" (Art. 157).

The conception of the State as the overseer of industry and the protector of labour finds expression in the institution of the "Councils," which no doubt represent the measure of success achieved by the Independent Socialists and the supporters of a "Soviet" form of government in their struggle with the conservative elements in the nation. There are to be for the workers Works' Councils, District Workers' Councils, and a Central Workers' Council, all duly recognised by the law. These are to be combined with the representatives of employers to form District Economic Councils and a Central Economic Council, and these latter are to include "representatives of all important professional groups in proportion to their economic and social importance," a phrase which one must interpret as best one can. The functions of the Local Councils are very vaguely described, and here the scheme is only an outline which it is left to time to fill in; but the place of the Central Economic Council in political life is more fully defined. First, all Bills on social and economic matters must be submitted to it for consideration before being introduced into Parliament; secondly, it is entitled itself to initiate such Bills, and to appoint one of its members to support them in the *Reichstag*, while the Government is bound to submit the Council's Bills to the Legislature. On the other hand, the *Reichstag* is not bound to accept the findings of the Council, nor does the Council possess any actual legislative power or any power of veto. Its functions are purely advisory; it has a right to be consulted and to express its views, but no more. Its actual power may therefore not be great at first, but it clearly contains within itself the potentialities of an extremely influential political organ.

The Constitution, as a whole, embodies the triumph of moderate, sensible, conservative democracy. There has been a political revolution in Germany, but there has been no social revolution. From that catastrophe the nation has been saved by the solid good sense and sobriety of the majority of the people. The German of to-day does not live in the clouds. He is no dreamy idealist. With what firmness and clear-headedness he confronts the eternal problems of politics may be seen from Art. 48: "Should any *Land* fail to fulfil the obligations imposed upon it by the Constitution or laws of the Realm, the President of the Realm may constrain it thereto by armed force." And the next clause empowers him to use force to secure public order and safety, and, if necessary, partially to suspend the Constitution.

Sir William Crookes, O.M.

The Discoverer of Thallium

SIR WILLIAM CROOKES'S death in the spring of last year at the advanced age of eighty-seven seemed to break the last link of the chain of great chemists of the past generation. He was the son of Joseph Crookes, who came to London a poor lad and worked his way to a man of considerable means by his own ability, so that he was able to indulge his son's whim to study chemistry, a profession which, it must be confessed, is still little more than a hobby.

At the early age of sixteen he entered the Royal College of Chemistry under Hofmann and at once showed signs of his great ability in research, publishing his first paper in the *Quarterly Journal of the Chemical Society* at the age of only nineteen. This was on the Selenocyanides, and the seleniferous material he used in this research was given him by his chief and came from the sulphuric acid works at Tilkerode in the Hartz ; the material is of interest apart from the paper above referred to, for it was while examining it with the spectroscope some years later that Crookes made the discovery which will always be associated with his name. The spectroscope was first used as an instrument of research by Bunsen and Kirchhoff in 1860, and it was in March of 1861 that Crookes was impelled to look at his seleniferous material with the instrument, with the result that he noticed a peculiar green line, which was found to be caused by the new element Thallium. He prepared and exhibited specimens of this new metal for the International Exhibition of 1862 and gained a medal for his exhibit. The next year he was elected a Fellow of the Royal Society. The extreme care expended on the determination of the atomic weight of the new element well illustrates the accuracy which characterised all his work. In this determination he made use of the vacuum balance and encountered some quite unexpected phenomena, which on investigation led to his second discovery of the Radiometer in the year 1875. These little instruments, which one used to see in the shop windows of the scientific instrument makers in London, give one the nearest idea of perpetual motion that one can get, as one does not at first realise that it is the light which makes the small cup-like vanes rotate on their pivot in the little glass bulbs from which the air has been withdrawn.

Crookes next turned his attention to the study of the phenomena exhibited by the electric discharge in rarefied gases, and more especially to the dark space around the negative pole, which has since been referred to as the Crookes or Cathode Dark Space.

In 1880 his discoveries in molecular physics and

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radiant matter won for him the prizes and medal of the French Académie des Sciences. In his suggestion of the existence of what he called the meta-elements he seems to have foreshadowed the modern idea of isotopes, an article on which appeared in the February issue of DISCOVERY. This was in connection with his extensive study of the rare earths, the separation of which he attempted by an elaborate method of chemical fractionation assisted with the spectroscope. This work occupied more than twenty years and led to the very full study of the element Scandium.

In 1889 the Royal Society awarded Crookes the Davy medal. He was now acknowledged to be the greatest exponent of the spectroscope in this country, and it was on this account that Sir William Ramsay sent him a specimen of his newly discovered terrestial Helium for spectroscopic examination and confirmation.

Madame Curie's discovery of Radium led Crookes to turn his attention to radiography, the result of which was the invention of the spinthariscope, a little instrument for counting the scintillations of radio-active bodies.

In addition to the researches and discoveries referred to above, Sir William carried through some very important investigations for the Government and the Royal Society, chief among which was the Investigation of Glass Workers' Cataract, for which he produced a number of recipes for glasses which have proved of considerable use to the workers in cutting off the heat- and ultra-violet-rays which injured their eyes. It is quite impossible to refer to the publications of so industrious a life, but mention must be made of the *Chemical News*, of which he remained the sole editor from its inception in 1859 till 1906. It would not be right to omit reference to this great discoverer's excursions into the realms of Psychical Research, as he was just as serious about his study of Spiritualism as he was about his other scientific researches.

The reader will find a fuller biography in the *London Chemical Society's Journal* for April 1920.

Aristotle's *Ethics*

By H. Lang Jones, M.A.

Headmaster of Willaston School, Nantwich

" Idou, chelīdōn ! chelīdōn ! "

The cry, started by a keen-eyed youngster, is quickly caught up by others; and it acts like a charm. Wrestlers relax their grip, boxers cease to spar, throwers of disc and javelin pause in act to hurl, jumpers drop their weights, runners step back from the mark—even the trainer's switch is lowered; the older men strolling up and down the covered track turn and come out into the open; the lively groups in the porticoes and the rooms and recesses behind them break off their talk, and crowd into the spaces between the columns, their eyes blinking in the glare of the noonday sun.

" A swallow ! a swallow ! there it is." Across the courtyard it shoots, like a dark meteor against the background of gleaming marble, dives into the shadows where hang last year's nests " under a white Greek architrave," flashes out once more into the living sunlight, and is lost in the blue of cloudless skies. " It's spring now," say the boys; and a couple of them (come to Athens with their parents, across the water from Rhodes, to see the stage-plays at the great spring festival of Dionysus) begin to chant—

> " She's come, she's come, the swallow is here,
> That brings the season of the year ! "

Gradually the Lyceum resumes its wonted aspect of activity, with the naked bodies performing their varied movements in the courtyard and on the running-track, or in the cooler park beyond, while in the shadows of the colonnades breaks out afresh the clatter of tongues and nimble play of wits. Let us approach that group which is slowly pacing to and fro in one of the covered walks. The speaker is evidently one to command respect, though his appearance does not show that studied negligence which is usually affected by philosophers—perhaps because he has spent some years (as tutor to a prince named Alexander) at the royal court of Macedon.

" Human good, then," he is saying as we join the group, " human good consists in activity of the soul in accordance with virtue; or, if there be more virtues than one, according to the highest and most complete. Moreover, it must be in a life that is complete. For one swallow does not make a spring, nor one fine day; so also perfect happiness is not achieved in a single day or in a brief space of time." He pauses, to refresh his memory from the papyrus roll in his hand; and his disciples busy themselves with their wax-covered tablets and the iron pencil, or " stile," which they use to write on the wax.

. . . . .

Such is the setting of the *Ethics*—Aristotle's lectures on the Character of the Perfect Citizen. A more appropriate setting could not be desired. Here, in this " gymnasium " (just such another as the Academy, where Plato taught, and where his school continues), is one side of our Greek education—the training of the Body—in full operation before our eyes; let us, who make it our resort, use what is before us as we discuss the other side—the training of the Soul. The trainers yonder have their principles and rules; but these are

useless except in practice. Some, in considering what Character *is*, shall endeavour to determine also what it *ought to be*. "It is well said that a man becomes just by performing just actions, and self-controlled by acts of self-control. Yet most people neglect this, and, resorting to abstract theorising, fancy themselves philosophers, and hope by this means to achieve excellence—like invalids who pay careful attention as the doctors prescribe for them, and yet fail altogether to carry out their instructions."

And it is no more accident that leads Aristotle to draw so many of his illustrations from the training and treatment of the human body. One example has been given; here are others: "Too much exercise may impair the strength, as well as too little; and an excess and a deficiency of food and drink are both alike injurious to health." . . . "It is possible to go wrong in many ways, but right in one only; consequently the one is easy, and the other hard—easy to miss the mark, and hard to hit it." . . . "Men's actions make them what they are, as is clearly seen from those practising for an athletic contest: they are continuously in action." . . . "As in the Olympic games it is not the finest or strongest men present who are crowned victors, but only those who take part in the contests (for the prize-winners are found among these), so in life it is, of the men of noblest character, those who act rightly to whom the prizes are given." . . . "The prize of virtue is happiness."

Yet it must not be thought that the Greeks, least of all that men of the stamp of Aristotle and his pupils, were obsessed by athleticism. That their interests were by no means confined to bodily health and training can be seen by a glance at the other sources of those illustrations which at every turn illuminate and enliven the *Ethics*. Religion, mythology, history, politics, law, warfare, navigation, commerce, manufacture, ethnology, natural history, physiology, physics, mathematics, logic, art, literature, drama, music—all these are laid under contribution; and there is constant reference also to the tenets of other schools of thought, and to the traditional philosophy of proverbs.

Throughout this wealth and variety of illustration runs an unmistakably *personal* note—which is one of the reasons, indeed, for concluding that in the *Ethics* we have the substance of lectures rather than a formal treatise. We seem, for instance, to see the twinkle in those "small eyes" of his, as Aristotle refers (apropos of the pleasures of Touch) to the gourmand who "wished that his throat could be longer than a crane's"; or reminds his hearers that "people eat sweets in the theatre chiefly when the performance is indifferent"; or tells the story of the man who justified his beating of his father on the ground that

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" it runs in the family." And we can even catch the note of tenderness in the speaker's voice when he instances that " there is something splendid about a beautiful mug or ball as a gift for a child, though the actual cost may be paltry " ; or when he drops such a remark as this: " Children think those things best which are precious in their eyes."

The illustrations of the *Ethics*, then, reflect its setting in a peculiarly vivid way, both in particular—the actual scene of the discourses—and as regards the whole life and interests of the teacher and his disciples. The same light, in fact, is thrown on the *Ethics* by its illustrations as is thrown on the Gospels by the Parables, which not only reflect the general life of the day, but also bear, in almost every instance, the stamp of their origin, whether in Galilee or in Jerusalem. And a further parallel may be drawn between the *Ethics* and the Gospels. While making full allowance for the difference of sanction, we may venture to claim that the teaching of the Gentile philosopher also is of permanent value—that he still has a message for us to-day. Grounds for this claim will have appeared in some of the extracts already given ; let me conclude with a few passages—some of which, indeed, approximate very closely, in content if not in form, to familiar sayings of the New Testament—in which more abundant justification may be found :

" Friendship requires what is possible, and not what is strictly due ; for this is not possible in every case—for instance, in the honours paid to gods and parents : to these no man can ever make a full return." . . . " It is true of the good man, also, that he acts in many ways for the benefit of his friends and his country, and will even, if need be, lay down his life for them ; for he will throw away money and honours and all the good things for which men contend, claiming for himself that which is noble and right ; and he will prefer a great and short-lived joy to one that is tame and lasting, and a single great and noble action to many that are of small account." . . . " No honour is given to the man who makes no contribution to the common stock." . . . " An evil man can do ten thousand times as much harm as an evil brute." . . . " A man whose sickness is produced by reckless living and disregard of the doctors might have avoided that sickness at the outset, but now he has lost control he cannot help it any longer—just as he who has let a stone fly from his hand cannot recall it, and yet the throwing of it depended upon him." . . . " The training in definite habits from earliest years makes not a little difference, but a great deal—in fact, *all* the difference." . . . " Rest is not an end in itself, but only a means to renewed activity." . . . " Enjoyment is found in the activity of the present, the hope of the future, and the memory of the past." . . . " He who, loving the truth, speaks it in indifferent matters, will speak it still more in matters that are not indifferent." . . . " We must not listen to those who would have us as man care only for man's affairs, or as mortal only for such things as are mortal ; rather should we, as far as we are able, make ourselves like immortals, and use every endeavour to act according to the highest that is in us." . . .

Let so much have been said (as he would put it) concerning Aristotle and his *Ethics*.

There is a translation of the *Ethics*, by Chase, in the " Everyman's " Library (2*s*.) ; this has a useful bibliography, and an introduction by J. A. Smith—to the last paragraph of which special attention may be drawn. There are other modern translations by Peters (6*s*. 6*d*.) and Welldon (8*s*. 6*d*.). The " Loeb " edition (parallel text and translation) is, unfortunately, not yet out, though it is in preparation. The best plain text is Bywater's (Oxford), with its instructive index. Burnet's edition (15*s*.) has commentary. Mention may also be made of Muirhead's *Chapters from Aristotle's Ethics* (9*s*.), and Stock's *Aristotle's Ethics for English Readers* (6*s*.).

Reviews of Books

Psycho-Analysis. By Miss Barbara Low, B.A. (George Allen & Unwin, 5*s*. net.)

The publisher kindly sent me two copies of this work (one of which, may I say ? I returned), and perhaps Miss Low, by the methods of psycho-analysis, can explain why the former of these phenomena occurred. The book contains an account of the gist of Freud's work on the psychology of the unconscious as described in his books on Dreams and on the pyscho-pathology of everyday life. This account is given in a plain and understandable way, and, without sacrificing any salient points of the theory, by omitting the unnecessarily objectionable illustrations which occur in Freud's books. The chapters deal with the scope and significance of pyscho-analysis, mental life—conscious and unconscious, repressions, the rôle of the dream, treatment by psycho-analysis, and probable social and educational results.

A list of authoritative books on the subject is appended, and Dr. Ernest Jones, the President of the British Psycho-Analytical Society, contributes an introduction. A book to read in commencing a study of this subject.

Popular Chemical Dictionary. By C. T. Kingzett, F.I.C. (Baillière, 15*s*. net.)

A dictionary of this kind should be scientific yet simple, comprehensive yet concise, and as free from errors as human nature and the printers allow. To write it, the compiler must be a member of the overworking classes with a passion for explanation and a manner that never bores. Also he should avoid subscribing to a press-cutting

agency, if that be humanly possible, so as to avoid being depressed by the reviews that matter. For to be scientific yet simple is hard, and as soon as you breathe the word popular you are done. We like this book very much. It should appeal to the many who in their daily life and in sickness come across chemical terms whose meaning is unfamiliar to them. The ordinary dictionary probably does not mention these terms ; the full-dress chemical dictionary is too technical and too heavy, so that there is room for a book like Mr. Kingzett's, which, while aspiring to scientific accuracy, attempts to be simple.

In several cases, for example in Electrons, the explanation given is not a good one, but these are exceptional and the whole spirit of the book is helpful. If you wish to know what absinthe or aspirin is, or what the various inks are made of, or the constitution of verdigris, or what the average composition of coal-gas is, the dictionary will tell you without any trouble.

It might be a good thing if in a future edition an appendix were added giving the composition of the more common patent medicines and proprietary articles. What is the composition of Benger's food ? what the secret of " Milton " ? A compilation of this kind has already been made, but its inclusion in a useful dictionary like the one under review would make it more valuable.

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The editorial work is under the general supervision of Prof. Sir A. T. Quiller-Couch. Each volume is separately edited, but as regards notes it has been deemed wise to steer a middle course between the plain text and the heavily annotated editions of the past. Thus we start off with a very short introduction. Short notes are given at the foot of the pages containing the text (an excellent innovation), but only such as are necessary to explain obscure passages. Further comment is relegated to the

[*Continued on p.* 222

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The End of the World. By JOSEPH MCCABE. (Routledge, 6*s.* net.)

This is really a popular book on Astronomy, dealing more particularly with the question, "When will this earth of ours cease to be the home of man?" So it is a pity that what sounds like a quack title has been given to it. But the book itself is a good one, and a very interesting one too, and is sufficiently cautiously written to give a reader a scientific account of all that has been happening or being speculated upon recently in astronomy, without being, in Mr. Kipling's phrase, too "filthily technical."

There are three conceivable ways, it appears, in which the earth may come to an end. It may die prematurely, it may be cut off by a violent accident, it may "pass through the slow and chilling phases of old age into the rigor of death."

To discuss these possibilities, we must take the whole universe as our parish, and talk calmly in terms of billions of miles and in millions of years. We must not be disappointed when we are told that the very *nearest* fixed star is more than a quarter of a million times farther away than the sun. We must try and visualise a comet with a tail 100,000,000 miles in length, or a nebula which is 150,000,000,000,000 miles across. Once this sort of thing is mastered, one of the most interesting of sciences becomes pleasant.

Some of the subjects discussed by Mr. McCabe are the destruction of life upon the earth by earthquakes and volcanic eruptions, or by causes leading to the withdrawal of the air we breathe or the land we live upon, or by collision in space with comets, or by the dying of the sun. And in addition he has distilled from the mass of recent literature, and condensed for our benefit, a great amount of information on astronomy. The bearing of the newer views and theories upon the established truths of the science is very clearly discussed.

The conclusion of the whole matter is that, unless the universe develops properties of which at present we are in ignorance, this little planet of ours is quite safe for many millions of years.

A Textbook of Inorganic Chemistry. In ten volumes. Edited by DR. J. NEWTON FRIEND. Volumes i, iv, v, viii and first part of ix. Price 12*s.*, 16*s.*, 15*s.*, 12*s.* 6*d.*, and 18*s.* respectively. (Griffin.)

This is a series of books on chemistry on which the editor, his authors, and the publishers should be congratulated. It is a series that has been badly wanted, and which no library which pretends to be scientific can afford to do without. Chemists, as you know, arrange the elements in groups numbering 0 to 8, so that a volume on each of these nine groups, with an extra one to take in the overflow of one, gives us the ten under notice. The information is up-to-date, and references to the literature are given at the bottom of each page. The printing and setting are excellent.

OTHER BOOKS RECEIVED

Co-education and its part in a Complete Education. By I. H. BADLEY. (Heffer, 2*s.*)

Chaos and Order in Industry. By G. H. D. COLE. (Methuen, 7*s.* 6*d.* net.)

The Historical Method in Ethics, and other Essays. By JOHN HANDYSIDE. (University Press of Liverpool, 5*s.* net.)

What is Philosophy? By G. C. FIELD. (University Press of Liverpool, 2*s.* net.)

Australian Meteorology. By GRIFFITH TAYLOR, D.Sc. (Clarendon Press, 12*s.* 6*d.* net.)

A Guide to the Observatories at Delhi, Jaipur, Ujjain, and Benares. By G. R. Kaye. (Superintendent Government Printing, Calcutta, 3*s.* 6*d.*)

The Quest of the Indies. By RICHARD DARK. (Blackwell, 6*s.* net.)

The New Psychology and its Relation to Life. By A. G. TANSLEY. (Allen & Unwin, 10*s.* 6*d.* net.)

Everyday Chemistry. By W. ROBINSON. (Methuen, 3*s.* 6*d.* net.)

Vertebrate Zoology. By PROF. H. H. NEWMAN. (The Macmillan Company, 16*s.* net.)

Applied Eugenics. By P. POPENOE and R. H. JOHNSON. (The Macmillan Company, 14*s.* net.)

Early in the autumn Mr. Cecil Palmer will publish "*The Murder of Edwin Drood: Recounted by John Jasper. Being an attempted solution of the mystery based on Dickens's MS. and Memoranda,*" by Percy T. Carden, with an introduction by B. W. Matz. The last chapters of Dickens's novel were to be have been written by Jasper in his condemned cell, "as if told of another," and Mr. Carden has acted on this hint of Forster's, working into the narrative elucidating passages which he has discovered in Dickens's manuscript. A large-scale plan is included of the Cathedral Precincts of Rochester (Cloisterham), together with several seaplane photographs of the city; and there are appendices and notes in which Mr. Carden expounds his conclusions.